Factory
MANAGEMENT AND MAINTENANCE

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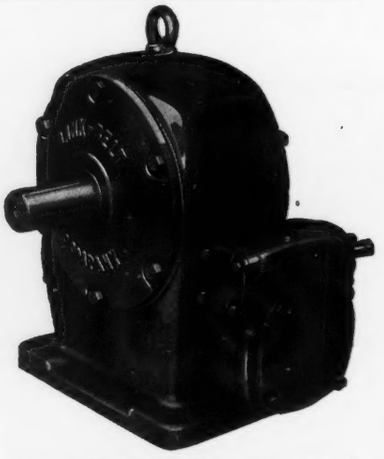

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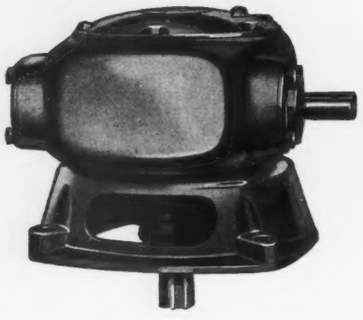

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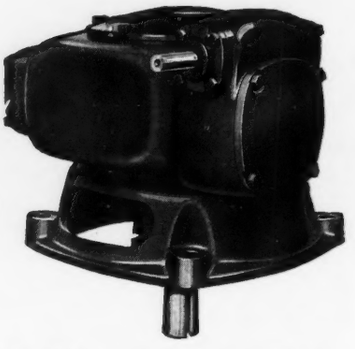

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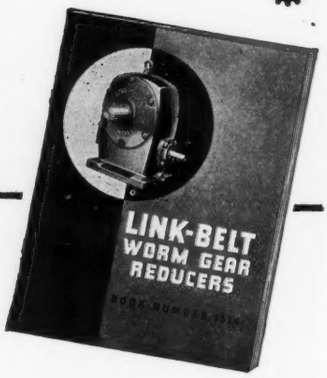

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L. C. MORROW
Editor

Factory
MANAGEMENT AND MAINTENANCE

Good Medicine

1936 will be different. In 1930 industry began tightening its belt; took up hole after hole through the next three years; held the last hole during 1934; only began to ease up during 1935.

Now, in 1936, the beginning of the end of the starvation period finds industry in need of a tonic. It is afflicted with an ingrained devotion to penuriousness. Plant and equipment have been neglected, standards lowered, skilled ranks depleted, training left undone, system crippled.

It is time to let the belt out a few holes—to change from a depression to a prosperity basis of thinking and acting. We thus propose a self-administered tonic. These are the things to do:

Fortify the plant personnel by training supervisors, workers, and apprentices.

Instruct the personnel in simple economics, to offset crack-pot theories that wealth can be distributed even though it is not created.

Provide equipment to obtain low-cost production.

Eliminate the wastes of ineffective plant layout and materials handling.

Improve production controls and re-establish production and quality standards.

Provide simple, effective incentives for management, supervision, and workers.

Set up and use workable systems of cost control and cost predetermination.

This program is one that profit-making plants follow regularly. It is good at any time, but particularly appropriate now that increased business is in sight.

It is a program that calls for the modernization of manpower, methods, and machinery.

WHERE BUICK'S $15,000,000

Based on an interview with
HARLOW H. CURTICE
President, Buick Motor Company

WENT

Equipment that did well enough even at the 1929 peak wouldn't do at all in 1936. Here is how Buick modernized foundry and forge

Millions for modernization! Buick bids for 1936 business. Its quick tricks—a "hot" car and a really "hot" plant to make it in

LAST MONTH, in the first of these three articles (December, page 498), the underlying policies that governed Buick's $15,000,000 rehabilitation were outlined. In this article and the one that follows, specific examples of the practical application of those policies have been taken from forge shop and foundry, from motor-building and sheet-metal departments.

A number of factors governed the purchase of new equipment for the forge plant:

1. The need for added capacity;
2. Engineering changes;
3. The necessity of cutting costs.

Added capacity was needed to produce gear blanks and clusters for Pontiac and Olds transmissions. This is new business acquired on a competitive basis. Taking care of the increased production was largely a matter of buying new and faster equipment, with quality increased by taking advantage of the greater accuracy available in modern forging machinery. Also, by changing the method of forging, the flow lines of the metal have been controlled to produce a stronger gear blank with the same amount of material.

Actually, 39 new machines were installed in the forge shop, and 49 were scrapped or surplused. The fact that the daily tonnage was greatly increased, *with 10 fewer machines,* is indicative of the relative productive capacity of the modern equipment.

Engineering changes in the engine also called for added quality, and in crankshafts this quality could not be obtained on existing equipment. Furthermore, this added value had to be obtained, if possible, at lower manufacturing cost, not only in the forging operations themselves, but also in subsequent machining operations. This ideal can be approached through the medium of more accurate forgings, thereby reducing the amount of metal to be removed as chips in machining.

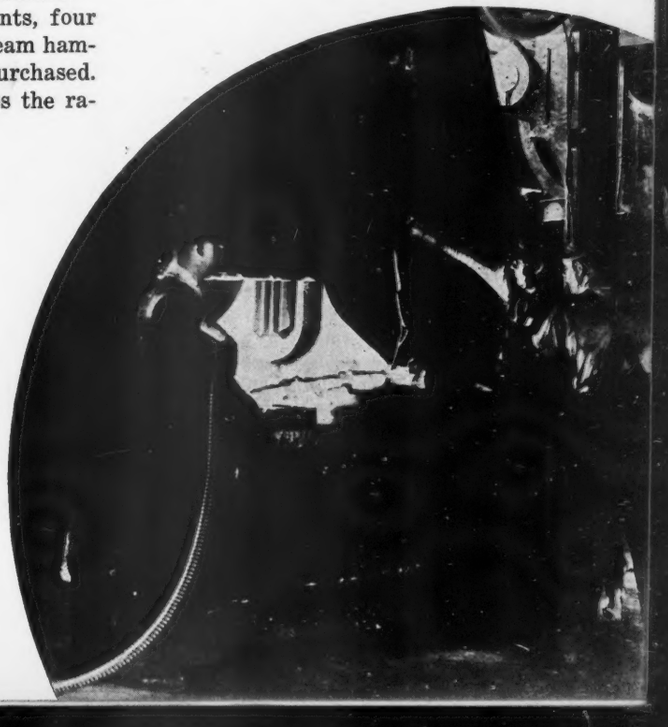
One of the many successful features of the Model 40 Buick introduced in 1934 is a crankshaft having the counterweights forged integrally instead of being bolted on. Hence the engineering department decided to incorporate the same idea in the larger engine that powers the new Series 60, 80, and 90 cars. This requirement called for the heaviest crankshaft forging yet handled, and one for which no adequate equipment was then available.

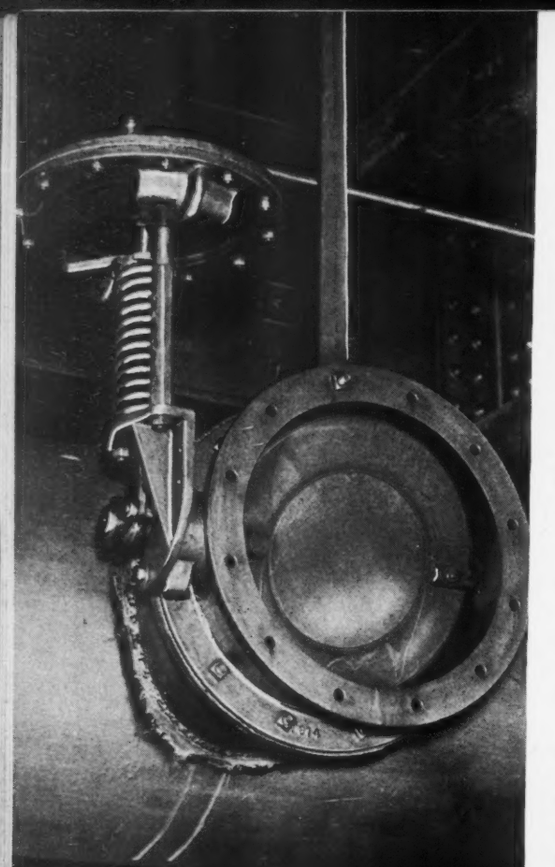
Besides, the additional requirement of reducing the allowance for machining to a minimum meant not only a more accurate forging, but also one in which the draft or taper on any vertical face (as it lay in the die) did not exceed 3 deg. instead of the usual 7. The purpose of draft, of course, is to prevent the hot forging from wedging in the die. A forging with 3-deg. draft was not workable in an old-style steam hammer. What is needed is a smart rebound of the upper die and falling weight. Rebound is related to the amount of absorption of impact by the anvil block and to the speed of steam admission on the bottom of the piston on the upward stroke.

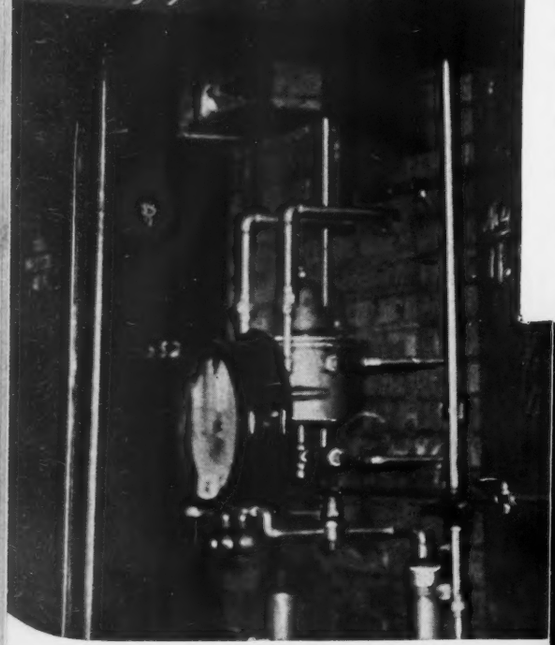
To meet these requirements, four of the largest heavy-duty steam hammers in the world were purchased. In these mammoth machines the ratio of the weight of falling parts (15,000 lb.) to the weight of the anvil block (315,000 lb.) is 1:21 instead of the usual 1:15. This new ratio assures sharp rebound. At the same time there is sufficient mass in the anvil to absorb the shock produced and prevent it from being transmitted to the foundations. In addition, the cylinders are double ported on the bottom side to give extra fast steam admission on the upstroke.

Special foundations had to be prepared to hold these hammers, which weigh over 200 tons. They rest on a crib of oak timbers, 4 ft. thick, recessed in a 20-ft. cube of concrete.

It used to be the practice to forge crankshafts out of round bar stock. In the new layout it is possible to use square billets with rounded corners, at an appreciable reduction in cost. For the larger crankshafts, these billets weigh 220 lb. apiece, and the method of handling them is important. In place of stationary furnaces, two mechanical pusher-type furnaces have been built, allowing cold billets to be charged at one end and hot ones "scooped" out at the hot zone. I-beam monorails with trolleys and hooks serve as transfer agents between furnaces, hammers, and trim presses. Two practically identical layouts are used, one for the small crankshaft, the other for the larger one. The equip-







Cupola output has been increased from 18 to 24 tons an hour through more precise control—of air volume in the tuyeres, for example. An air volume indicator actuates this butterfly valve . . . Six of the eight foundry conveyors have been replaced by new ones mounted on roller bearings to cut power requirements, increase speed, reduce maintenance costs . . . Sorting conveyor (on opposite page) facilitates segregation of small castings on way from shakeout screens to cleaning room

ment is all new, with the exception of one upsetting machine used for a simple operation.

Another change made in the forge shop to assure dimensional accuracy, hence machine shop economy later on, is in the final sizing operation on the crankshaft. Usual practice is to restrike the crankshaft following the twisting operation in which two of the cranks are set at 90 deg. to the others. A serious objection, however, is that the temperature of the forging by the time it reaches this point may vary by as much as 300 deg. F. Because of this variation, the cold length will show wide differences, which must be compensated for by additional allowances for machining operations.

In the new line-up, the sizing operation does not take place until the crankshaft has gone through the hardening furnace, and just before the water quench. Then, instead of being restruck, which is an instantaneous matter, the crankshaft is squeezed for an appreciable length of time in a hydraulic press. The metal gets more of a chance to adjust itself, and as a result less cold straightening is required.

Automatic controls assure uniform forging temperature; hence the size to which the crankshaft shrinks when cold is uniform.

Incidentally, all the heat-treating furnaces, which are of Buick design and build, are new. So is the 5-arm pneumatic pickling machine.

Also the Foundry

Revisions made in the foundry are typical examples of modernization objectives:

1. Replacement of obsolete equipment;
2. Precise control of operations;
3. Reduction of operating cost;
4. Lower maintenance costs;
5. Improved working conditions;
6. Greater volume in the same floor space.

The foundry was full of obsolete equipment dating back to the years between 1916 and 1926. This equipment served the purpose even for the peak production year of 1929, but that was when only cylinder blocks, heads, and transmission cases were cast. Today every gray-iron casting going into Buick cars is cast here, as well as Pontiac and Olds transmission cases and Olds engines.

No cupolas have been added, but by precise control of cupola operation an increase in output from 18

to 24 tons an hour has been obtained. With air volume indicators it is now possible exactly to proportion the air blast in the tuyeres to the amount of coke and iron charged per unit of time. Signal lights, actuated by the hot metal shorting carbon electrodes within the cupola, tell the operator how much molten metal is within the well so that he can cut the blast when the well is full.

One of the dirtiest, most dangerous, and hottest jobs in a foundry is raking out the slag discharged on the floor from the back end of the cupola. A slag conveyor has eliminated all this. It consists of a drag chain running in a water-filled trough behind the row of cupolas. When the hot slag hits the water, it shatters, and the fractured particles are conveyed to a dump outside the building. Its chief value is as road material around the plant.

On the foundry floor are eight continuous table-type conveyors on which the molds are poured and cooled, and from which they are dumped. Six of the old conveyors have been replaced with modern types running on roller bearings. The old drag conveyors consumed six times the power to operate and were subject to rapid wear. Besides, they did not have the necessary speed range to handle the variety of castings now encountered, nor was it possible to speed them up without danger of failure. The present speed range is from 12 to 48 ft. per min., governed by the size and type of casting. All these conveyors have hoods to draw off the smoke and fumes during the cooling stage.

High-speed, motor-driven vibrating screens have been installed at the shake-outs. They replace pneumatic screens and handle a greater volume of sand with less dust and less flask breakage.

Doubled Capacity

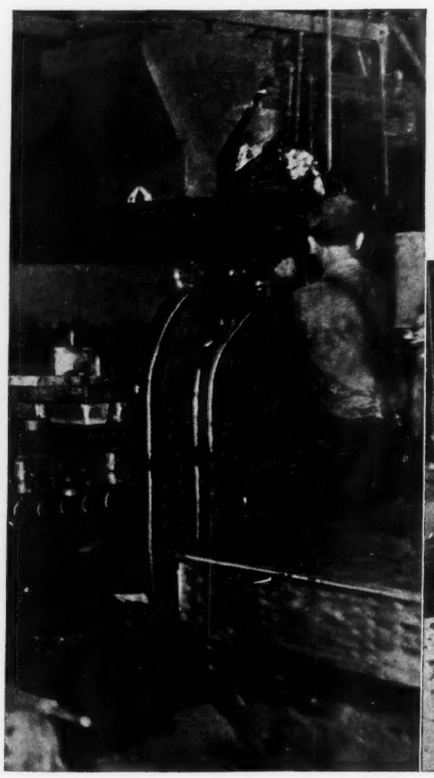
For simplification of maintenance repairs, Buick has standardized on a single type of molding machine. Fourteen new sets that will turn out 85 to 125 copes and drags an hour replace the old machines whose corresponding output was 45 to 60.

Largely to obtain uniform quality in large and small cores going through the same drying oven, and to eliminate condensation of water from the products of combustion in a direct heating unit, the core-oven heating has been modernized. Through the use of an indirect oil-fired system, heated air, uncontaminated by burned gases, is blown through the ovens from ten heating units. Oven temperature does not vary more than 2 deg. between any two parts.

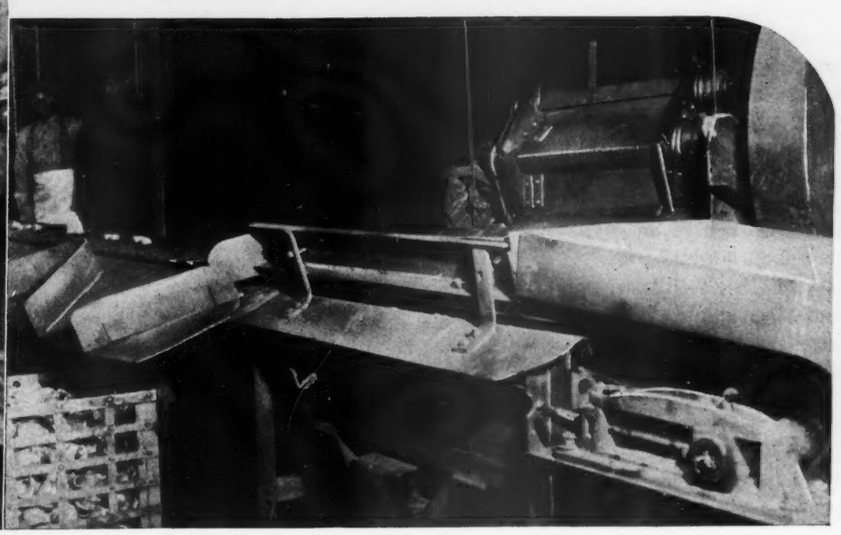
To increase capacity in the same space, a battery of eleven core sand blowers have been installed. Compared with a rammed core, three-quarters of the weight is saved in the blown type. Reinforcing wires are eliminated, simplifying sand recovery, and gas is absent in the shake-out process. The space saved is used to provide a reservior or bank of cores to take care of fluctuations in demand in the pouring room.

To cut down the length of haul to the machine shop, a new shipping dock has been built. Also, a sorting conveyor has been added to expedite the segregation of small castings on the way to the cleaning room. The castings are dumped indiscriminately on a steel slat conveyor, and are picked off by hooks and thrown into the proper baskets.

Modernization of the foundry will not end here. Bids are now being received for what will be one of the most extensive air-conditioning systems in any foundry—all in the interest of better working conditions.

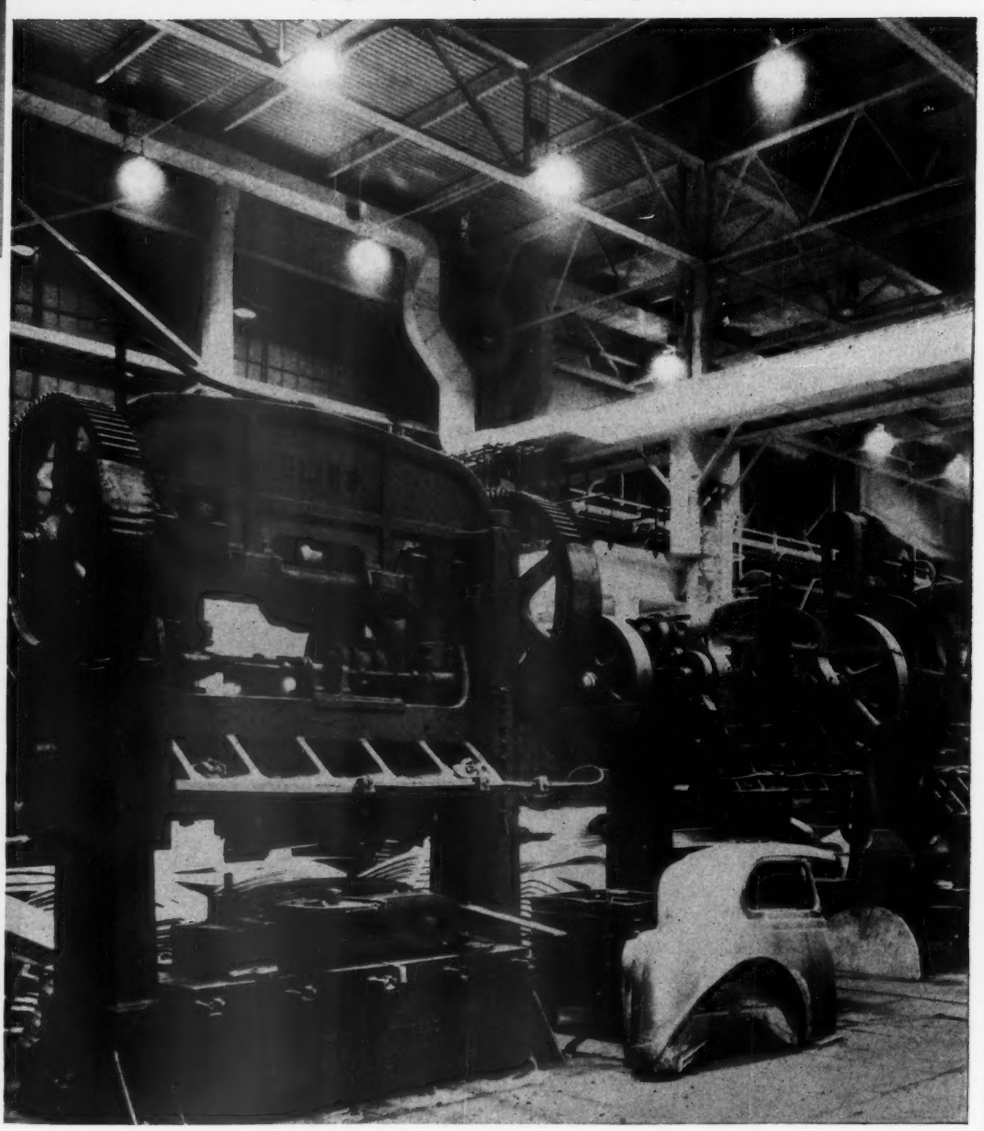


A third article—in February—will conclude Buick's modernization story with a description of the changes that have been made in motor-building and sheet-metal departments



They're H.I.M.V. Lamps

(high-intensity mercury-vapor)



FIFTY high - intensity mercury - vapor lamps (400 watts) team with 50 Mazda incandescents to give 75 foot-candles of light at minimum current cost in the coil-winding department at Philco Radio & Television Corporation, Philadelphia. Used alternately in Glassteel diffusers mounted 10 ft. above the floor and spaced 8 ft. apart. . . . Press department at Briggs Manufacturing Company, Detroit. Open deep - bowl reflectors mounted 40 ft. high, spaced 15 ft. apart, equipped with 400 - watt high - intensity mercury - vapor lamps. Average intensity, 22 foot-candles, unusually high but not a bit too much for the class of work. (Photographs from General Electric Company, Nela, Park, Cleveland.)

Fifty Electrical Years

Improved methods and lower costs have closely followed adoption of equipment developed by the electrical industry

G. A. VAN BRUNT
Associate Editor

THIS month the Westinghouse Electric & Manufacturing Company celebrates the golden anniversary of its founding. In view of the important part that this organization has played in the development of the electrical industry it is fitting to consider some of its outstanding contributions to the present widespread electrification of industry.

Probably the most significant development took form when George Westinghouse, in 1885, conceived the principles of the a.c. system of power distribution. Experience with long-distance transmission of natural gas under high pressure and its reduction by suitable devices to lower pressure for general use made him quick to recognize the possibilities of the Gaulard and Gibbs transformer as a "pressure reducer" in an electrical system.

1886

Originally the primaries of these transformers were connected in series, and any change in the number of lamps connected to the secondary circuit seriously affected the voltage in the remaining lamps.

Upon acquiring the patent rights to this European device, Mr. Westinghouse assigned William Stanley to the task of adapting the so-called "inductorium" to commercial service. A number of transformers were built for operation in parallel to reduce the line potential of 500 volts to 100 volts for lamp circuits. Storms of criticism assailed the young inventor for his apparent temerity in connecting to a 500-volt circuit a coil with an ohmic resistance of approximately 1 ohm.

So little was known about reactance and impedance by those familiar only with Ohm's law and direct currents that scoffers were dumbfounded when those transformers actually worked with a Siemens generator imported from England and were used to supply lighting service on a commercial basis during the spring of 1886 to a number of stores in Great Barrington, Massachusetts.

Such was the beginning of the a.c. system in America, which opened the way for a new era in electrical developments. This little plant with its 25-light transformers operated for several months, until a screwdriver accidentally dropped into the generator wrecked the coils.

A new alternator designed by Mr. Stanley was built in Pittsburgh and soon a.c. central stations appeared, first at Greensburg, Pa., then at Buffalo, N. Y., and elsewhere. Two years after the starting of the initial plant at Great Barrington, there were nearly a hundred a.c. electric light stations in operation.

When this system was launched there was no meter available to measure the energy used by the customers, and it soon became imperative to devise some method of doing so. To this problem Mr. Westinghouse assigned Oliver B. Shallenberger, a 28-year old engineer. In less than a month the induction-type ampere-hour meter was a reality.

Like some other famous inventions, the principle of this meter was discovered accidentally. A piece of watch spring, lying on the magnet core of an a.c. arc lamp, began to rotate slowly on its own axis when the current was turned on. Watching the spring young Shallenberger perceived how an induction meter could be made. That was in 1888; now the principles of alternating current measurement discovered by Shallenberger are found in all a.c. watthour meters.

1936

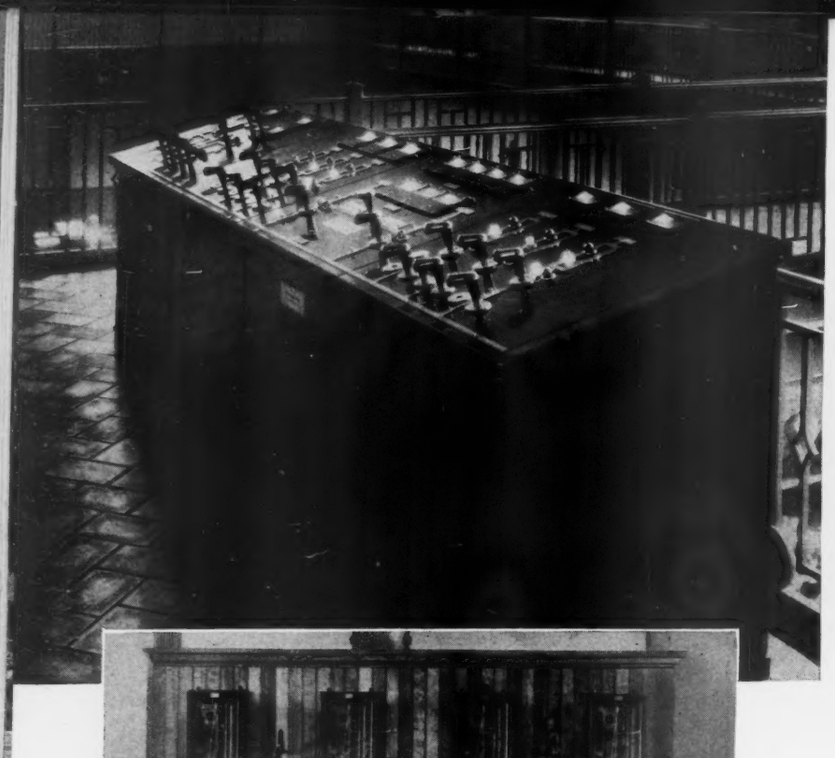
About this time Mr. Westinghouse saw the need for a motor to put alternating current to work. While investigating this subject, he heard of the polyphase motor patented by Nikola Tesla. He acquired these patents and engaged Mr. Tesla to carry on further development work. By 1890 a number of these motors had been built.

One of the first motors of this type to be built commercially was placed in service in the Far West for driving mining machinery.

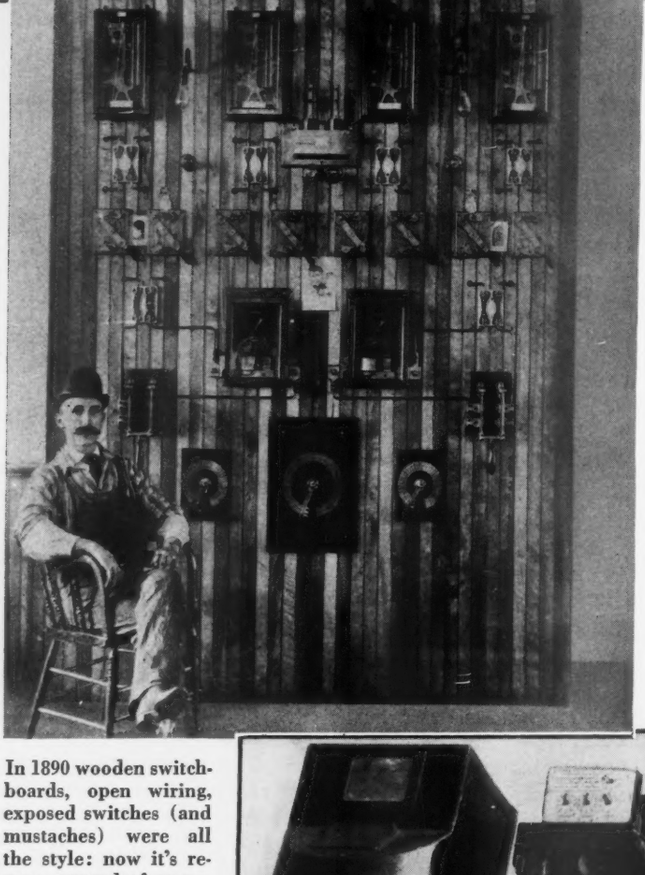
Because all existing power systems were single phase, 125 to 133 cycles, there was no market for polyphase motors. Development work was carried on, however, and by 1893 a number of central stations were equipped with two-phase generators rated 50 to 750 kw. This turn in events created a demand for motors.

The Westinghouse Company was able to supply this demand with the type B induction motor, the first really commercial machine. It was widely sold up to 1907; then the type C motor appeared. Designed for simplicity and reliability, all slip-rings, external secondary resistors, and short-circuiting devices were eliminated. Equipped with the rotating, squirrel-cage secondary this machine formed the basis of present-day induction motor design, electrically as well as mechanically.

Recognizing the importance of maintaining correct lamp voltage at the end of feeders with different line losses, a young Westinghouse engineer named Stillwell attacked this problem and in the fall of 1888 devised a feeder voltage regulator in the form of an auto-transformer whose primary was shunted across the lines; the secondary, with a tap-changing switch, was in series with the supply line. It was a development of epoch-making importance in the electrical engineering field. Replaced in time by a continuous type

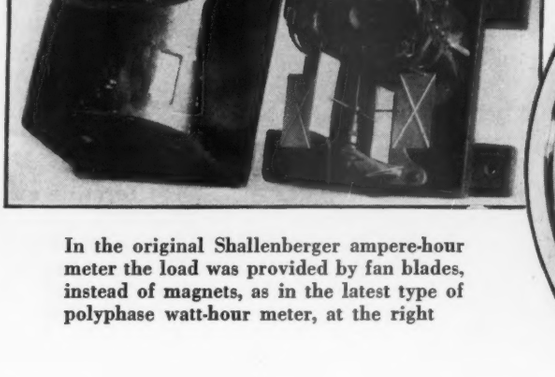


Early squirrel-cage motor starters merely started and stopped the motor. Today's model, in addition, provides protection for motor, machine, circuit, and operator

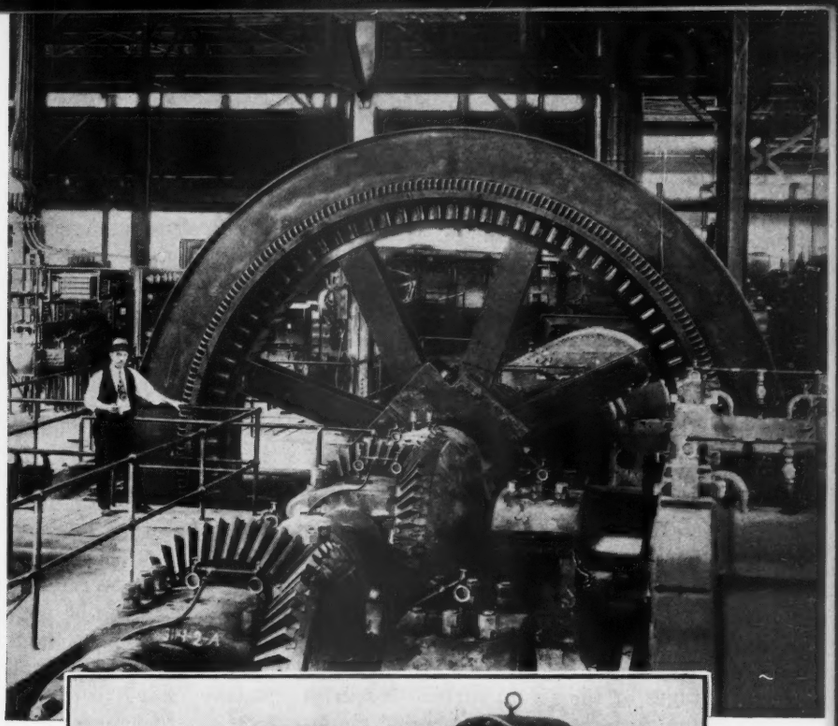


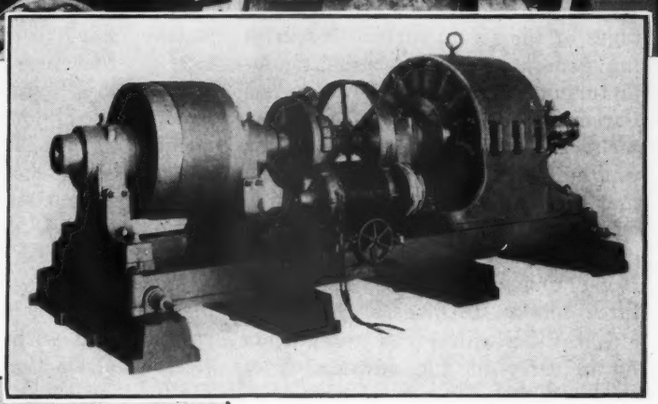
In 1890 wooden switchboards, open wiring, exposed switches (and mustaches) were all the style: now it's remote control of power circuits

As the Camera Records **Electrical**



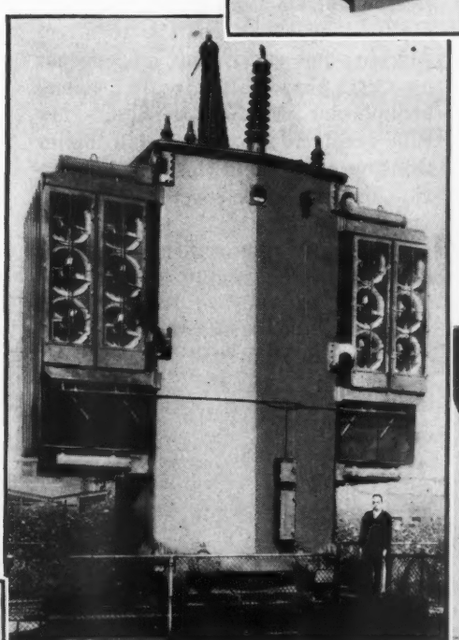
In the original Shallenberger ampere-hour meter the load was provided by fan blades, instead of magnets, as in the latest type of polyphase watt-hour meter, at the right





The first synchronous motors had to be started by a small, separate motor and the load applied by a clutch. At the top is a synchronous motor having the largest diameter of any yet installed, and rated 5,000 hp.

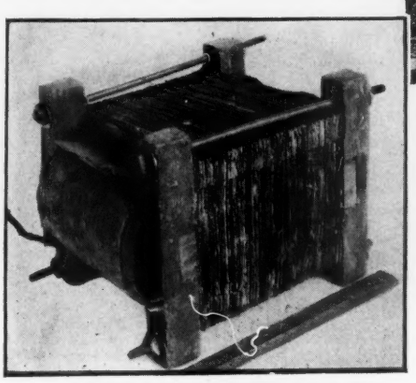
Progress

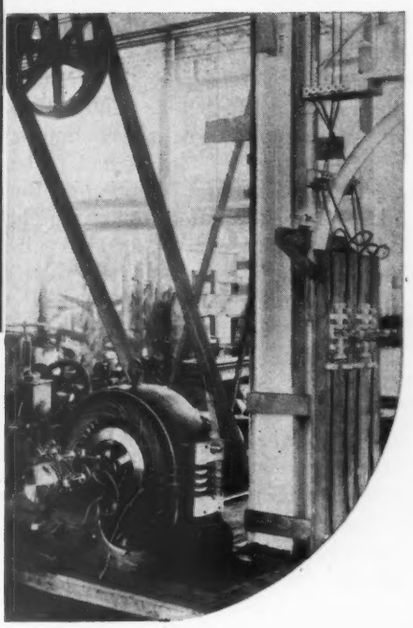


This 65,000-kva., 238,000-volt transformer is a lineal descendant of the crude, 25-light transformer built in 1885 by William Stanley

•

One of the earliest installations of a polyphase motor. Starting switches were mounted on a wooden panel fastened to the building column





of induction regulator, it is fitting to record that the Stillwell idea has been revived in the latest type of regulator, which permits change of taps under load.

As the demands for electric power grew, the time came when reciprocating steam engines could not be built large enough for the generators. The limit was reached when four huge steam cylinders were required to drive each of the 5,000-kw. alternators, 43 ft. in diameter, installed for the New York elevated and subway lines in 1901.

Turbines Arrive

Several years before this Mr. Westinghouse realized the advantages of the steam turbine for driving generators, and secured manufacturing rights from Sir Charles Parsons of London. In 1896 an experimental 120-kw. turbine-generator was built, but it was not until 1899 that the first commercial installation was made. In that year, the power house of the Westinghouse Air Brake Company was equipped with three 400-kw. turbines.

With the widespread recognition by industry of the advantages of electric drive, the use of motors on large steel mill drives was foreseen. As early as 1905, two 1,500-hp. Westinghouse d.c. motors were installed in the Edgar Thompson Works of the Carnegie Steel Company for driving rail mills. They are still in active operation.

Another milestone in electrical pioneering was passed in 1909, when the Westinghouse company developed the self-starting synchronous motor, now almost as adaptable to industrial drives as the polyphase induction motor. As early as 1890 a 100-hp. single-phase synchronous motor had been installed, but it had to be started by a separate driving motor and the load applied by a clutch. Even with its low starting and pull-in torques, the self-starting synchronous motor found wide use.

About 1927 the all-fabricated synchronous motor was announced and because of its many improvements in torque, efficiency, and ability to correct power factor, it has decided advantages over the faithful squirrel-cage motor on many drives.

Paper, an indispensable material, requires an average of 750 kw.-hr. per ton for its production. So pulp and paper mills have many electric drive problems peculiarly their own. Outstanding among the specialized drives in these mills is the intricate machine that makes paper.

In 1919 Westinghouse developed a new system of paper-machine drive wherein all section motors were synchronized to operate at exact relative speeds. When it is considered that to make good, strong paper, without breaking or straining the sheet between sections, there cannot be a speed variation between sections of more than 0.1 per cent, the importance of this development to the paper industry can be appreciated.

Two great new industries, radio broadcasting and the talking moving picture, have been founded since 1921 on the characteristics of electronic tubes. In 1926 came the Knowles grid-glow tube, the first member of a host of devices that marked the transition point from the application of electron tubes for entertainment uses only to myriads of time- and labor-saving devices.

The grid-glow tube was a valuable discovery because it provides in one compact unit without moving parts, electric valve action, amplifier action, rectification of alternating to direct current, and control of tube output by a grid phase shift circuit. Among commercial uses of the grid-glow tube are included control of complex lighting effects and the direct operation of adjustable-speed d.c. motors from a.c. circuits.

One of the newest members of the electronic tube family is the Ignitron. This is an ignitron-controlled, mercury-pool rectifier tube, which can be built to supply thousands of amperes and many hundreds of kilowatts. It can be used as a rectifier to convert a.c. to d.c., as an inverter to change d.c. to a.c. at any desired frequency, or to change alternating current from one frequency to another. When used for spot welding, the amount of current and time of application can be varied at will.

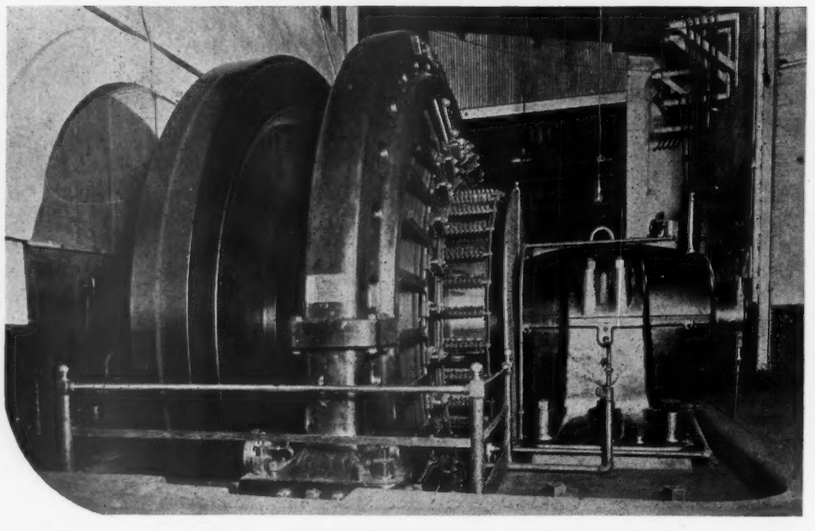
Ultimate in Power?

When, in 1925, a giant 8,000-hp. d.c. motor was used to drive a 54-in. reversing blooming mill in the Homestead Works of Carnegie Steel Company, it was thought that the ultimate in power had been reached. However, the demands of the steel industry for more and more power are insatiable. In 1930 the South Chicago Works of the Illinois Steel Company started its new 54-in. reversing mill driven by 10,000 hp. in Westinghouse motors, each main roll being driven by a 5,000-hp. unit.

Not long afterward this mill lost its distinction as the most powerful when a 12,500-hp., 44-in. slabbing mill started operation in the same plant. Metal is rolled on all four sides at once. Not only are the main rolls driven individually by 5,000-hp. motors, but an additional 2,500-hp. motor drives the edging rolls.

With technical progress working at such a fast pace, it requires courage indeed to predict what future developments in electrical applications hold for American industry.

When this 1,500-hp. motor, the first large one applied to a main roll drive, was installed in 1905 a roomful of steel rails had to be used as the starting resistor



How a 200-Man Plant CONTROLS PRODUCTION

BILLY E. GOETZ
Industrial Engineer
E. O. Sessions & Company, Chicago

THE production control procedures here outlined were designed for an actual company and have been proved by practice. Professional obligation to a client makes it impossible to identify the company; if it will add concreteness to the picture, think of it as manufacturing typewriters, or sewing machines, or calculating equipment. Two sizes are produced in each of five models. The company carries an inventory of over 3,000 items in raw steel, piece parts, sub-assemblies, and finished product. Piece parts are produced in lots of from 50 to 2,000. Approximately 50 orders, each calling for the performance of from 1 to 15 operations, are dispatched daily to the factory, which employs approximately 200.

Former cost and control systems revolved about the perpetual inventory and the goods-in-process ledger. Shop orders originated with the stock clerk when any item of stock, raw or worked, was drawn down to the minimum. Upon receiving a memorandum to this effect, the production clerk issued a production order directing the factory to withdraw the materials, perform the operations, and deliver the completed job to stores. A carbon copy of the production order carried the caption "Cost sheet" and was filed in a work-in-process ledger, to which costs, as taken from time cards and material requisitions, were posted.

Steel and Order

Production order original was delivered to the raw steel stock clerk, who sent steel and order to the department indicated.

The cost record of the job, to which were posted time cards, material, requisitions, and final notice of materials received at stores, served not only to give the cost of the job when finished, but also as a record of progress. The production clerk went through it every morning, noting and tracing all orders that should have been returned to stock. He also traced any shortages of parts reported by the stock clerk. Tracing was a process of calling on foreman after foreman until the job was located. The clerk then tried to get the materials moving as fast as possible.

Set up especially for a small plant engaged in "intermittent-repetitive" manufacture, this method tells both shop superintendent and cost accountant *what* they need to know *when* they need to know it

The more important disadvantages of this plan were:

1. No provision was made to balance machine loads. Material and production order arrived together at the operating department. The foreman, without advance notifications, routed the material to whatever machine was first available. This resulted in running much more work than necessary on older, or heavier, higher-cost machines, as well as in departmental jams and, worst of all, delayed orders.

2. Posting of time cards to the work-in-process ledger was delayed at best two days after performance of the operation. Consequently there were normally about 100 orders in the ledger on which work had been completed. The production clerk, relying on the goods-in-process record, was regularly tracing these orders after they had been completed. On occasion, posting got two weeks behind—during taking of physical inventories, closing of books, or change in cost clerks. At such times the goods-in-process ledger was useless as a control device.

3. Orders were not traced until they were supposed to be completed and in stock. It frequently turned out that delayed orders were still in the first operating department when tracing began. Assembly operations were then held up and terrific pressure applied to complete the delayed order. This resulted in larger spoilage, delay of other orders, and many split orders. After getting "burnt" a number of times, the production clerk marked more orders "rush."

4. Because of delays in production, extended time allowances for production, and a general breakdown of control, the inventory had increased $100,000 over an earlier period when output was 20 per cent greater.

6. Production was so haphazard that no proper standards as to time or cost could be obtained by studying past experience. Costs had risen above any reasonable level.

7. Internal checks were not pro-

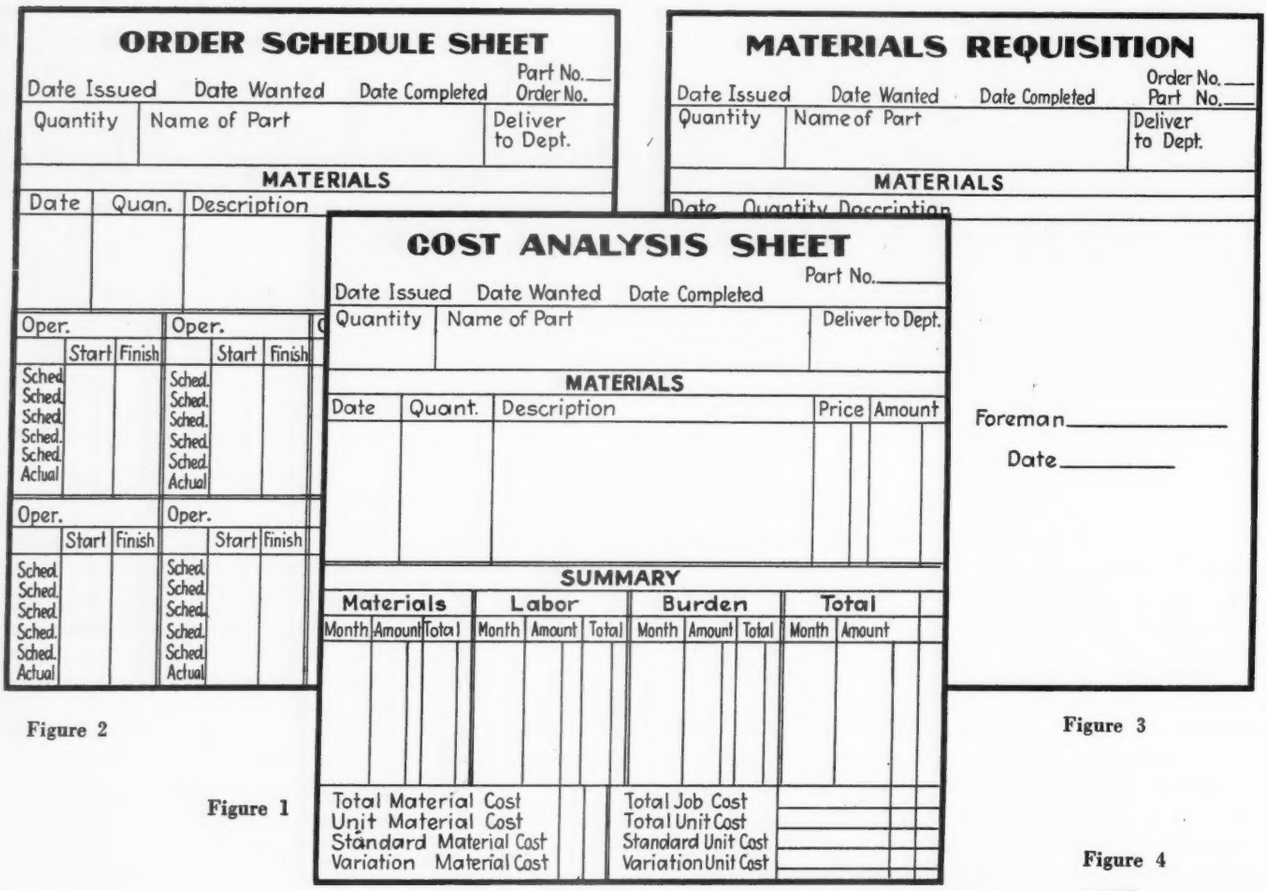


Figure 2

Figure 1

Figure 3

Figure 4

vided. It was common practice for foremen to conceal spoilage by obtaining extra material from the stock clerk, who wrote the requisition as called for by the foreman. No provision existed for informing executives of such conditions.

8. A large amount of clerical labor was performed by shop foremen. They made out time cards. They receipted for materials, in many instances ordered them. They requisitioned tools. And after a few frantic experiences with tracing of delayed orders, most of them had set up informal records of their own as to receipt, operations, spoilage, and delivery of materials. All this clerical work seriously impeded their effective functioning as foremen and increased costs.

It was apparent that improvement was needed. Analysis aimed at the preparation of a production control manual disclosed a need for the following reports:

1. Reports on idle machines and on machines with an inadequate volume of work planned ahead—to enable better balancing of load.

2. Reports on piece parts falling below minimum — to forestall delays at the assembly line due to part shortage.

3. Reports on machines behind schedule—to locate troubles in the shop, and assist in shifting orders from overloaded machines to machines short of work.

4. Reports on orders behind schedule.

5. Reports comparing operations with past or standard performance—these to be of a "flag" nature, reporting only items out of line.

6. Monthly reports on depart-

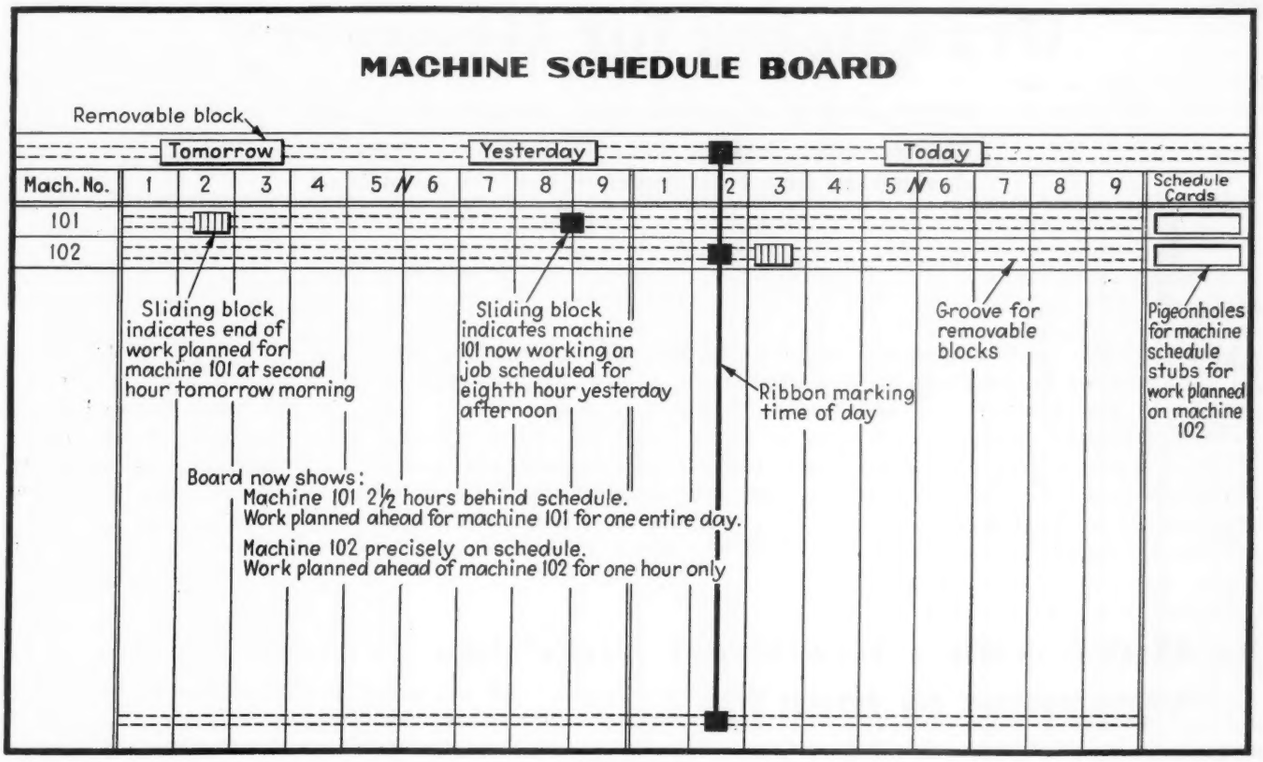

MACHINE SCHEDULE BOARD
Removable block
Tomorrow
Yesterday
Today
Mach. No.
1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9
Schedule Cards
101
102
Sliding block indicates end of work planned for machine 101 at second hour tomorrow morning
Sliding block indicates machine 101 now working on job scheduled for eighth hour yesterday afternoon
Groove for removable blocks
Pigeonholes for machine schedule stubs for work planned on machine 102
Ribbon marking time of day
Board now shows:
Machine 101 2½ hours behind schedule.
Work planned ahead for machine 101 for one entire day.
Machine 102 precisely on schedule.
Work planned ahead of machine 102 for one hour only

Figure 5

ments, showing whether they are operating as effectively as standards require.

Let us begin the description of the new plan at the point where the planning executive initiates a production order.

The planning executive makes out a memo of orders. This merely gives parts numbers, quantities, and machine numbers of the equipment that is to do the processing. This memo goes to the production clerk at the next desk.

The production clerk puts carbons into a pad containing a cost analysis sheet, an order schedule sheet, and a materials requisition sheet in rotation. These forms are illustrated in Figures 1, 2, and 3. He also makes out for the order a machine schedule and work ticket (Figure 4) which are in duplicate, except for the heading.

The production clerk files the order schedule (Figure 2) by part number. He tears off the stubs of the machine schedule sheet and distributes them to the appropriate pigeonholes in a machine schedule board (Figure 5). The cost analysis sheet is handed to the cost clerk at the next desk. The materials requisition, the work ticket, and a master card (Figure 6) are sent to the stockroom. The master cards are permanent records kept on file by the production clerk. They are protected by an envelope which is transparent on one side to enable shop men to read the card without removing it. The envelope contains a pocket for the materials requisition and the work ticket.

The stock clerk receives materials requisitions, work ticket, and master card. As he issues the material he enters the requisition on his bin tags. If the balance shown on the bin tag falls below the minimum shown at the top of the tag when he deducts the quantity requisitioned, he notifies the production clerk by a

(Continued on advertising page 40)

Req._____ Style_____ **MASTER CARD** Symbol_____
Date_____ Used in_____ Assembly

Material_____ Rockwell Test_____
Remarks_____ Bin No._____
_____ Lbs. per M_____ Lengths_____ Blanks in_____ Length 1 Length_____ Lbs.____ Count Length by Weight_____
Closed Open Stripper Opening_____ Narrowest Strip_____ Remarks_____
Name

No.	OPERATIONS	Tool No.	Bin No.	Mach. No.		Std Time 1000 pcs.
	Remarks					

Figure 6

Organizing for Recovery

First of five articles that scrutinize going organization plans, suggest ways to rebuild decimated human structures for the job ahead

FREDERICK A. SMITH
President, Miller, Franklin, Basset & Company
New York

ONE of the most disquieting symptoms of the prolonged depression to the informed and experienced industrial manager, is the extent to which so many manufacturing concerns have allowed their organizations to disintegrate.

When the rebound occurs, as it must, this negligence is going to impose a severe handicap upon the recovery of lost business. Makers of established products may find themselves on a par with competitive beginners. Their former superiority of brains and skill will have disappeared with the men they have lost.

1. Have you conserved your investment in men?

Many of the big concerns have not allowed this disintegration. On the contrary, they have made heroic efforts to give all hands some employment. The Westinghouse Electric & Manufacturing Company, for example, divided its total working force into three shifts. Each shift worked one week, laid off the next two weeks. In this way everybody had work and wages, little as they were.

At the same time (1933-1934) this company was taking on special jobs such as machining the huge gates for Boulder and other dams to give the deserted shops something to do. During the same period Henry Ford kept his plants going so as to employ all hands at least part-time. He declares that this plan resulted in a loss during one year of $85,000,000. Such an imposing price was he willing to pay to meet his obligations as an employer and to keep his working force from disintegrating.

Now, while the great industrial corporations were carrying out some such plan of holding their organizations together, the smaller manufacturers did not follow their example to the extent one might expect. To be sure, old established industries, especially in the metal-working trades, which had always imitated the organization pattern of their big rivals, have strained every point to keep their people at least partly busy. That is the bright side of the picture.

The reverse is not so flattering, either to the foresight, courage, or humanity of so many other plant heads—those who have let their organizations fall apart. Most of them, in fact, have followed about the same procedure in destroying their organizations. As incoming orders fell away to nothing, these plant heads gave way to panic. "Cut salaries, cut wages," was the cry. Then "Cut hours, cut numbers, cut all possible corners." Finally came the fatal order: "Cut the executive force from top to bottom in all departments—sales, engineering, accounting, production." Now here is where the ax was applied not wisely, but too well. Also, the method of the executioner varied, but the results were equally mortal.

Resignations by Request

Sometimes the big executives, those at the very top, were released by the directors, the banks, or other creditors, or by the receivers. Sometimes assistants were fired and their work was added to that of their principals. Or the principals were requested to resign and their assistants were promoted into their places, with little or no increase in salary. This was often regarded as a highly

. . . where the ax was applied, not wisely but too well. Methods varied; results were equally mortal

ingenious and satisfactory economy, whereas nothing could be less so.

If this process had been limited to office executives, the effect upon the future of the business would have been serious enough. Unhappily for the fortunes of all concerned, it did not stop there. The rolls of manufacturing executives, from works managers and superintendents down to the last foreman, have been decimated with as much ruthlessness and as little foresight as the office rosters.

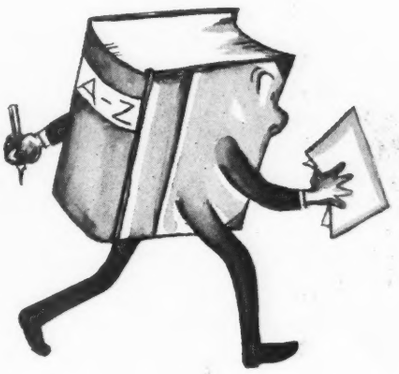
Now every manufacturer ought to know that he has an investment—in hard dollars—in each member of his plant organization, down to the lowliest helper. This investment is made up of the cost of learning time, spoilage while learning and afterwards, until expert; insurance, benefits, facilities; finally, administrative expense.

The more highly trained the employee may be, and the oftener he has been promoted, the greater is the investment in him. For each time he is shifted to a new job, another increment is added to his total learning time and expense. When a man so trained has been a department foreman for a while he becomes a walking encyclopedia of detailed information regarding the capacity of each man and the idiosyncracies of each piece of equipment in his division, and of the ways of his brother-foremen, his superiors, and the company's customers. All this he carries around in his head, where there is also an infallible history of his department and the various models of the product that have passed through it in his time. It is impossible fully to replace such a man because he takes his memory away with him.

Longer to Learn

As we proceed upward in the scale of executives, the company's investment becomes increasingly important. Not only is the amount paid them much greater, but so also is the length of the learning time. Indeed, if the executive is the right kind, he is always progressing, so that his learning time is practically continuous.

The financial investment in the man, however, is not by any means the measure of his full value to the company that trained him. The talent and ability of that man as developed by his training, his knowledge of the company's product, markets, and competitors, all represent a built-up reserve of far greater dollar value than any that appears on the annual statement. Yet these are the men who have been let go during these years of stress. Thus has one of industry's prime investments been dissipated beyond recall.



. . . a walking encyclopedia, difficult to replace because he takes his memory away with him

Not Available

When the business recovery arrives, the older executives will no longer be available at their former ratings, either because they have made shift to get along in other directions or because their broken morale will have impaired, if not destroyed, their usefulness. The younger men, on the other hand, will lack the experience and practical expertness that would fit them to replace the older ones. Besides, they will most likely be drawn into the flood of new establishments that always follow closely upon an advancing wave of prosperity.

Even in the best of times, industrial organizations have varied widely in training, efficiency, teamwork, and natural ability. The weak ones have managed to get by in competition with the strong, because there was plenty of business to go around. But it requires no prophetic gifts to foresee that this will hardly be the case in the sharp competition that will ensue upon the realignment of business in the near future.

Whether that inevitable competition can be met successfully or not by established concerns, which have been able to weather these five years of adversity, depends largely upon the courage, speed, and thoroughness with which they go about reorganization, not of their financial but of their human structures.

The pressing problem, then, is: How to go about a reorganization of industrial personnel in the light of past practice, present demoralization, and future probabilities. It must be done—but how?

Three Ways to Run a Plant

Let us see what we can learn by scrutinizing the virtues and vices of some of the accepted plans of organizing production, sales, and executive forces. We may then be able to suggest prompt and practical ways and means of rebuilding organizations that will be equal to the demands soon to be placed on them.

The numerous plans of conducting manufacturing establishments may be divided roughly into three general classifications: (1) The "one-man" business; (2) the "outside-talent" business; (3) the "built-up-from-the-inside" business.

In the next three articles we shall consider three case histories of organizations under each of these three classifications. Our effort will be to show their good and bad points and, what is of more immediate concern, the results of each.

To eliminate other variables that might confuse the issue, the three cases are drawn from the same industry. For our purpose, it need be identified only as one concerned with the manufacture of a universal article of wearing apparel.

In February—the sad case of Mr. A and his one-man organization

Five on This Handling Team

Four monorails, one overhead chain, do all the grunting and sweating in Packard rear axle and frame assembly

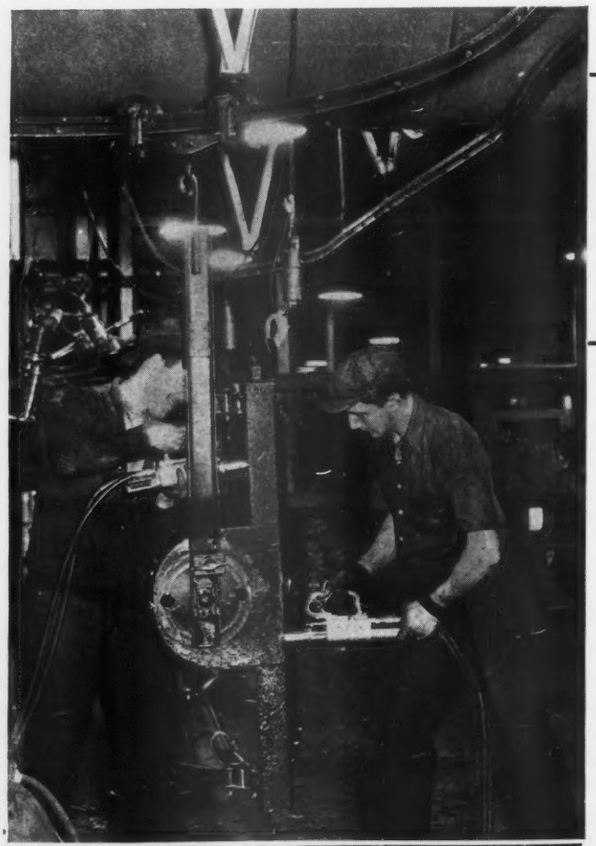
ARTHUR VAN VLISSINGEN, JR.
Special Correspondent, Chicago

BY TEAMING together two or more types of materials handling equipment to care for a specialized set of operations, the advantages of well-engineered conveying can frequently be multiplied. An unusually effective gearing together of several pieces of handling equipment is used at the One Twenty plant of Packard Motor Car Company, Detroit, to tie together several operations that reach their climax when the completed rear axle assembly is assembled into the completed frame.

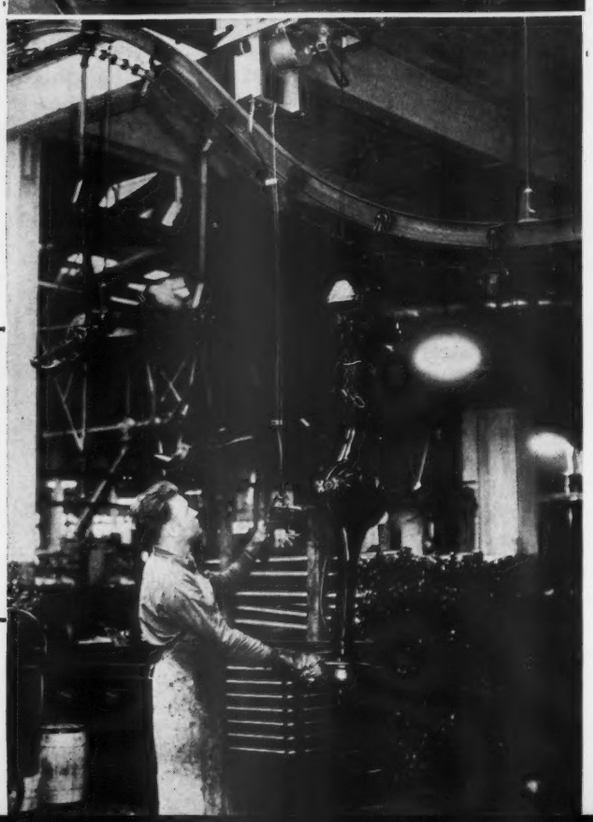
A Neat Trick

The frame conveyor approaching this point consists of two hand-push monorails. The frame, suspended from swivel hooks, first moves along broadside for a series of operations. Now the monorails are brought close together. The result is a neat trick of materials handling, for the frame reverses itself and turns lengthwise of the track.

The below-the-hook fixture carrying the frame also is swiveled in the lengthwise horizontal plane. This swivel is equipped with a locking device, so that it is simple for a workman to set the frame at the angle most convenient for his operation. He then works along at this efficient angle. If he has successive operations requiring various angles, he changes the angle each time by a quick, simple reset.



Frame conveyor consists of two hand-push overhead rails which converge at this point. Frame promptly reverses itself, turns lengthwise. Fixture is swiveled, with locking device that permits workmen to set frame at most convenient working angle



Rear axles move toward assembly on overhead chain. At this point an electric monorail runs parallel to the chain, moves at same rate of speed. Workman hooks the monorail to the axle, lifts it off the chain, carries it to a nearby bench for a final operation

At Any Angle

Before this method was devised, it used to be necessary to hoist and upset frames at various points along a frame line, since various jobs must be done in definite sequence, requiring some work above and some underneath. And the best to be had from the ordinary hoist and upset was to have the frame in a plane parallel to the floor, whereas now it can be held at any angle whatever.

For the moment let us leave the frame suspended from its double monorail track, parallel to the direc-

tion of the track. We now come to the rear axle. The axles swing along on an overhead chain conveyor, hanging up and down. Then, at the point where they are needed for assembling into the frame, another monorail runs parallel to the overhead chain.

This monorail is only about twenty feet long. It is equipped with an electric power hoist, travels by electric power, is curved at the end from which it starts, merely for clearance to keep it out of the way when not in operation.

Rail and Chain Get Together

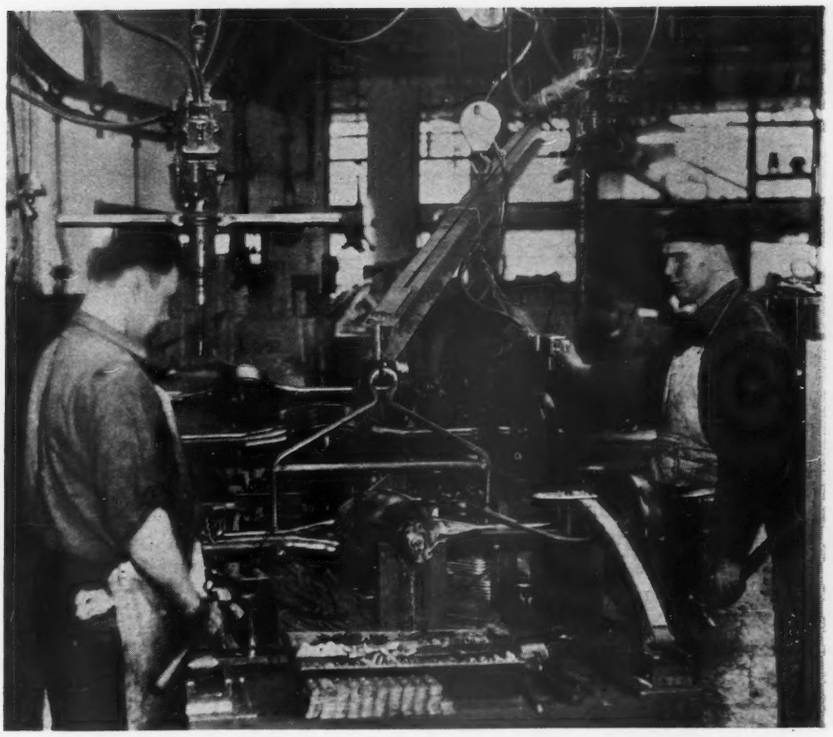
As an axle comes along, the workman starts the electric monorail carrier, which thereupon runs alongside the axle; at this stage, monorail and chain are only six inches apart and parallel. Moreover, they move at identical rates of travel. The workman walks alongside, hooks the monorail hook onto the rear axle, then with the electric hoist lifts it off the overhead chain. As soon as the monorail has picked the axle off the chain, it carries the axle over to a rack on a bench. Here one final operation is performed upon the rear axle before assembling it into the frame.

The far end of the monorail is just beyond the end of this rack bench. Now another monorail, hereafter to be referred to as Monorail B, enters the layout. Monorail B is hung about two feet below the first monorail, and thus overlaps a short distance just above the bench. It also is equipped with electric hoist and electric motion carrier with pushbutton control.

Toward Final Assembly

As soon as the operation upon the rear axle has been completed, Monorail B picks up the axle from the rack bench and carries it on a curving path for the full length of Monorail B, which is only a matter of fifteen feet.

At the end of this curve, the rear axle meets the frame. You will recall that we left the frame suspended from its double monorail track, parallel to the track. At this point, where frame and axle meet, the axle is assembled into the frame and the piece moves on toward final assembly.



Monorail B picks up the axle as soon as the final operation is completed, carries it along a curving path of 15 feet. At the end of the path, axle meets frame, is assembled into it, and the piece moves on to final assembly

TAX DIFFERENTLY to Stimulate Production

DONALD HORNE
Tax Counselor, Institute for Economic Research
New York

A proposal to stimulate capital investment, and therefore production, by lowering the income tax rate on income invested in durable goods. In weighing the soundness of this proposal, bear in mind that there exists a need for durable goods, reliably estimated at over $18,000,000,000

SUPPOSE an individual receives $1,000 of income which he might, under ordinary conditions, invest in productive enterprise, but which, under present conditions, he is inclined to allow to remain uninvested. Suppose his tax on the $1,000 amounts to 50 per cent, or $500.

Now suppose the Government says to him, in a law which applies to everyone willing to take advantage of it, "If you will invest this $1,000 in durable goods, we will reduce the income tax on it by 25 per cent."

The reduction would amount to $125. If the individual accepts this option, the amount he risks is only $875, for his tax liability is immediately decreased by the difference between the $1,000 actually invested and the $875 actually risked. The degree of risk to the invester would thus be very substantially reduced. The government would be encouraging a line of activity which would tend to replenish the source from which future income taxes necessarily must be drawn.

Such an inducement could properly be made only with respect to the purchase of original issues of common or preferred stocks and income bonds of productive enterprises, and to the purchase of durable goods. There is no object to be gained by inducing the taking over of a risk already assumed by another, and certainly none to be gained by encouraging the lending of money on security, that is, on the borrower's risk.

The present low rate of interest shows that the lending of money needs no encouragement. In order to obtain the benefit of the proposed inducement, one must be willing to look to the success of the productive venture for his profit. Such a provision in the income tax law would tend to make use of income for other than direct investment in further production relatively unprofitable.

There is a natural penalty for allowing money to lie idle; it is loss of profit. This penalty is being paid, and on a large scale, by the loss of the difference between normal interest and the low interest now obtainable. This penalty would be enhanced by the further loss of the reduction which might be obtained by putting the money into wealth-producing channels. This would not, however, affect existing capital, but only income permitted to join non-productive capital.

Now why be concerned about how Uncle Sam collects his income tax? Because what is most needed at the present time is an inducement for risking investments in capital goods.

In a period like the present, industry is faced with a great risk in making new investment, and it is therefore wise not only from the standpoint of the business man and producer but also from that of the government, which depends on the increase and flow of wealth for its existence, to consider ways and means of lessening that risk.

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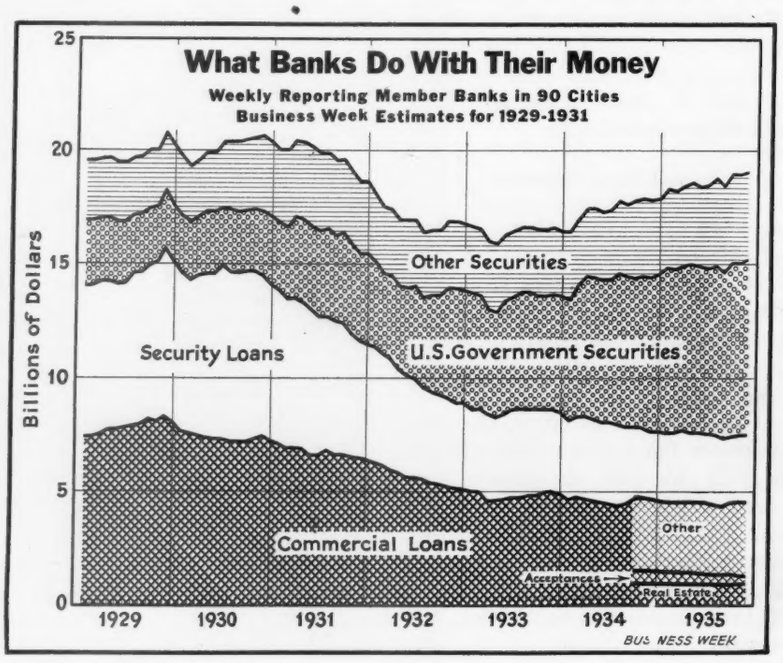
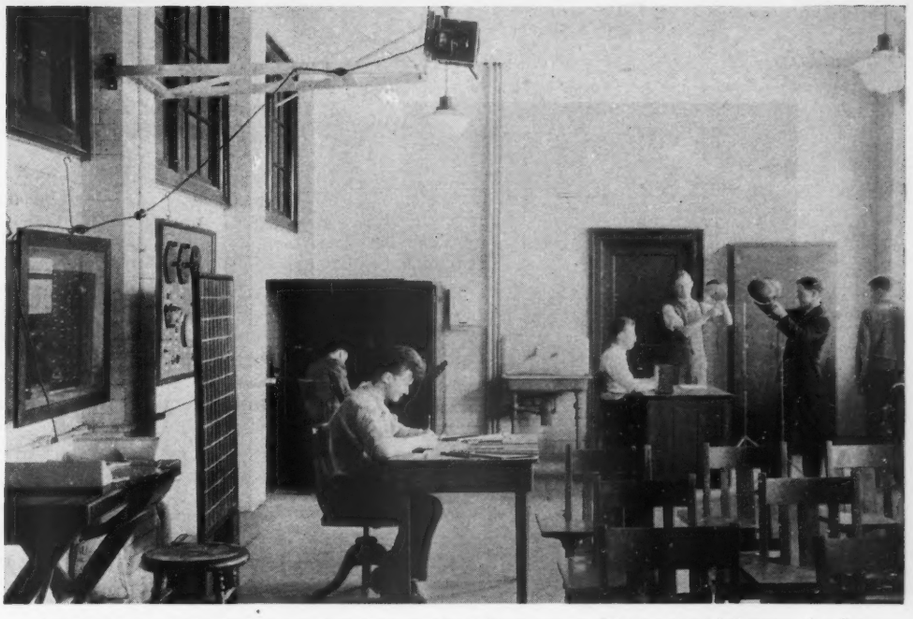




Students at work in time and motion study laboratory at University of Iowa. At the rear, a projection booth and a group of students making motion pictures of an assembly operation. Note camera mounted on crane above set-up to photograph hand motions

MOTION MINDS IN THE MAKING

RALPH M. BARNES
Professor of Industrial Engineering
University of Iowa

Technical schools sense need for trained motion-study men, are turning out youngsters who have the "makings" — not only Iowa, but also Cornell, M.I.T., N.Y.U., Armour Institute, Penn State, and Purdue

ENGINEERING college graduates are largely absorbed by industry, hence the requirements of the latter have always had an important influence in shaping the curricula of our technical schools. It is not surprising, therefore, in view of industry's recent successes in applying motion study technique, to find that a number of schools are now offering courses in that subject.

It is true that a few schools have been offering instruction in stopwatch time study for the past 25 years, but much of that instruction has been limited in its scope. Today the objectives of time study are much broader and more inclusive than they used to be. In fact, time and motion study may now be defined as *the analysis of the methods, materials, tools, and equipment used, or to be used, in the performance of a piece of work; the development of the most economical way of doing this work; the standardization of these methods, materials, tools, and equipment; and the accurate determination of the time required by an average operator to do it.*

Undergraduate work in time and motion study at the University of Iowa is presented in two courses, both elective. In the first course two semester hours are devoted to stopwatch time study, motion study, and micromotion study. It is followed by a second course of two semester hours in which further practice is given in micromotion technique, accompanied by investigations and studies of hand motions, skill, fatigue, "energy cost" of doing work, physiology of the human body as it pertains to muscular work, and other essential factors.

Decimal-minute stopwatches and time-study boards of the conventional type are supplied to each student for his individual use during the course. Special slide rules, speed counters, tachometers, speed-and-feed charts, and data on cutting metals are available. Our new mechanical engineering building contains machine shop, forge and heat-treating laboratory, foundry, and wood products laboratory, all of which supply the students with plenty of actual subject material. Nearby industries also cooperate by supplying actual problems.

All the Necessary Tools

For micromotion work the laboratory is equipped with an Eastman Model A 16-mm. camera which may be either hand-cranked or driven by a synchronous electric motor to give a constant rate of film exposure. By means of a gear transmission, speeds of 1,000 to 4,000 exposures per minute may be obtained. The university also owns two spring-driven 16-mm. cameras which are available.

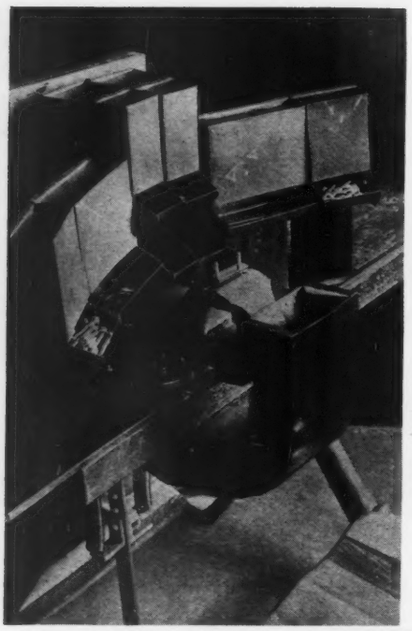
Our laboratory has an Eastman Model B Kodascope equipped with tachometer to indicate projection speeds directly in frames per minute. Five small projectors (Eastman Model C and DeVry) with 100-watt bulbs are available for film analysis.

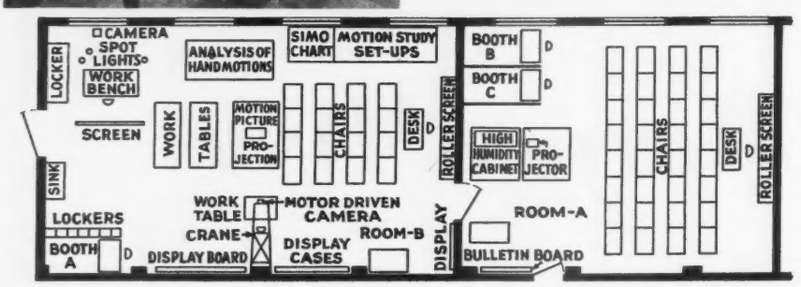
The laboratory has three small booths in which film analysis may be carried on without darkening the room. The entire laboratory or either of the two rooms (see diagram) may be darkened when extended film analysis is being carried on by members of the course.

A crane for mounting the motion camera is available for special problems and research work. A museum of wrenches, screw drivers, jigs, fixtures, and specimen set-ups is maintained for demonstration purposes.

Special equipment is available for

How About Mich.
What the hell do you think





experiments on accelerations and time of hand motions. Time measurements can be made with an accuracy of 1/1,000 of a second.

A textbook and lithoprinted manual are used in this course, and this material is supplemented by lectures and outsides reading from books and magazines listed in a special bibliography.

Since the students registered in this course have already taken a course in factory management, they are familiar with the general aspects of time and motion study, wage incentives, and related subjects.

Not more than fourteen students are permitted to register in one section. Two students ordinarily work together on long projects. The class meets for two 1-hour periods and one 3-hour period per week.

An outline of the work in stopwatch time study follows:

1. Review of objects and purposes.
2. Historical background and early use of time studies.
3. Steps in making a stopwatch time study.
4. Methods in taking times.
5. Determination of allowances.
6. Methods of "rating" and "leveling."
7. Study of "skill" and "effort."
8. Determination of standard data for elements of operations.
9. Development of data for building up synthetic time standards.
10. Formula construction.
11. Critical evaluation of each of the factors entering into the determination of a time standard.
12. Metal cutting.
13. Labor's objections to stopwatch time study—possible evils.

While the above material is being considered in the classroom, ten stopwatch time studies are made in the laboratory and shops by each student who takes the course.

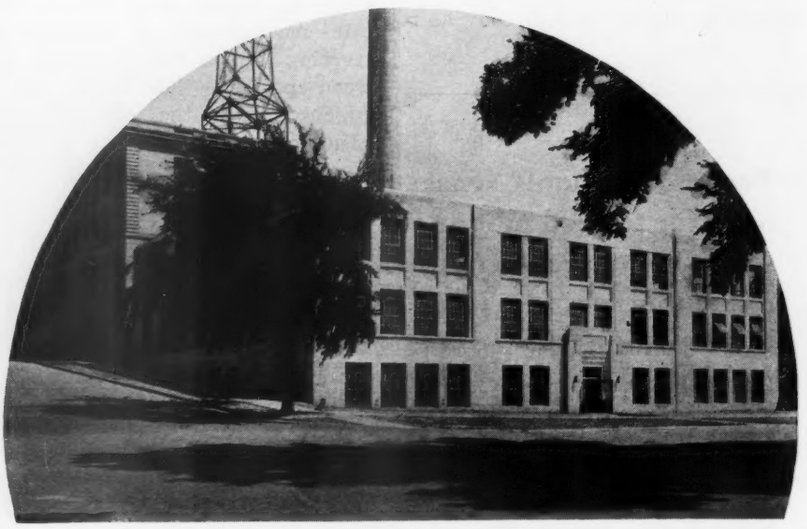
Motion pictures, demonstrations, and lectures are used to supplement the student's text and his regular outside reading assignments.

The work in motion study and micromotion study consists of the following:

1. Review of objects and purposes of motion study.
2. Historical background and early use of motion study.
3. Physiology of the human body as it affects muscular work.
4. Contributions of psychology to "the way to work."
5. Study of apparatus for making micromotion studies and movement analysis.
6. Process charts—over-all investigations for improving operating economy.
7. Definition of the eighteen therbligs with demonstration of each.
8. Study of each of the twenty-four principles of motion economy as explained in the motion study manual.
9. Economical use of micromotion study.
10. The engineer, overproduction, and unemployment.

Motion pictures are made of "old" and "new" methods. Each student analyzes the film and makes a chart of each. Because of the lack of time, all the students do not actually build the jigs and fixtures needed in working out their problems, but submit solutions in report form for class discussion. There are sufficient standard bins, vises, jigs, etc., available in the laboratory to permit some of the students to set up apparatus to demonstrate their proposed methods. One of the photographs shows a set-up for assembling a special two-plate clamp. This set-up was made in three hours with standard steel bins and a foot-operated bench vise.

Top. **Took a student three hours to make this assembly set-up. He used standard steel bins and a foot-operated bench vise.** ***Center.*** **Floor plan of motion study laboratory.** ***Below.*** **New mechanical engineering building**



THESE WORKERS run their own businesses

J. W. ESTERLINE
President, The Esterline-Angus Company
Indianapolis

This group assembles the chart drives used in Esterline-Angus instruments. Many special devices have been developed to assist the men in their work. A stroboscopic method of timing clocks has cut the time required to regulate a clock from two weeks to two minutes. A portable motor drill is used to wind the clocks. Compressed air machines force parts into place within a fraction of a thousandth of an inch

MUCH of the agitation of the past few years has been predicated on the assumption that we have accomplished all we can hope to accomplish under an individualistic system. Thus we have "Soak the Rich" and "Share the Wealth" programs based on the false notion that the general well-being can best be served by a process of redistribution, and matched by another notion, equally false, that the elimination of the profit motive would solve the problem.

Millions of Americans, in short, question the individualistic system and the profit motive—and the simple reason why they do is because in the daily routine of their lives they encounter no opportunity to exercise and express the normal instinct to profit personally by the development and use of the abilities they possess. The problem of industry is to direct this powerful force into productive channels, by giving each individual the incentive to exercise his motive to profit.

Twenty years ago Mr. Angus and I began a series of experiments. Our objective was to bring each employee to the place where, in his own interest, he would have the same incentive as the owners of the plant. The basis of the system is an appeal to the personal desire to profit, and the result has been the development of a rather unusual method of employee compensation which I described in a recent address before the Great Lakes Section of the American Institute of Electrical Engineers. In what follows, therefore, I can do no better than present a slightly abbreviated account of what I said at that time.

▼

Unusual compensation plan gives every employee the same incentive as the owners of the plant. Show us the industry where it won't work

▲

We began by admitting the heads of departments and their first assistants to a share in net profits. We asked them to suggest the percentage that should be thus distributed, and were surprised by their honesty. We have since increased it 50 per cent. Each share is sufficient to enable the man to earn more, over a period of years, than he could obtain elsewhere on a straight salary basis, and there is no maximum limit. Key men, who plan and direct the work of others, are able to see the relation between their work and net profits.

Productive manufacturing employees are divided into small groups, all men working on the same manufacturing orders comprising a group. The man who in most plants would be the foreman is a working leader of his group. Each is in effect a small contracting organization which receives the orders for furnishing the labor on the different shop orders executed by the group.

Cost Plus

The group accepts each order on a cost-plus basis. Cost is the actual wages applied on the job. The profit of the group is 40 per cent of the difference between this labor cost and what the cost would probably

▼

By distributing a portion of income *to create incentives to increase income*, we secure precisely the thing that solves the problem of general well-being — *abundance, widely distributed*

▲

be on a straight wage basis. The profits of each group are computed and paid once a month.

Out of its 60 per cent share the company pays the cost of accounting and provides the last word in equipment, which of course results in increased employee and company profits. The effect is to make each group a little contracting company, in business for themselves, with an opportunity to make a profit over their wages, depending upon their interest, skill, and industry. Hourly wage rates are less than the Indianapolis averages, but wages plus employee profits exceed them.

There Wasn't Any "Catch"

Some interesting things have come out of this business of changing employees into business men. At first they looked for the "catch." It took months to overcome this caution. Once they were convinced that the system was to be squarely and honestly administered, costs began to go down and the profits of the groups up.

Men began to want to learn more because it helped their income. Those who were members of unions have let the memberships expire; dues cost money, and the restrictive practices of the unions interfered with their business. If a member of one of these groups became careless or indifferent, the other members of the firm might suggest that he "snap into it" or retire. If the little firm needed another man, the members wanted to pick him, because they had some good workman in mind who would strengthen the firm and increase the profits.

They soon realized that, to stay in business, a firm must do its work right the first time, so now each group guarantees its work to the company just the same as any outside supplier does, and any spoilage is deducted from the group profits. Many are the suggestions which members of these groups have made, which have resulted in lower costs and increased profits.

Then we ran into a snag. These little firms were so intent upon their own business that it became difficult to get cooperation between groups. One good rule in lubricating machinery is to apply the lubricant where the heat or squeak is. We solved the cooperation problem by dividing each month among the group leaders an amount equal to 10 per cent of the total profit of all groups during the month.

Office employees, such as stenographers, order clerks, cost accountants, mailing and filing clerks, and telephone operators are placed in one group. In effect, they contract to do our office work for their wages plus one-half of the difference between actual office expenses and what office expenses were for the same volume of business before the system was adopted. Every office employee will voluntarily help out wherever the load is heaviest, because it keeps down the total expense. These employees have actually made a profit every six months during the depression, and I can see prosperity for them when business revives.

If they waste time, stamps, carbon paper, or what not, it costs them as well as us. One stenographer actually complained to the office manager that the president of the company used too many pencils. Perhaps he did, but it proved that our employees are watching the leaks and us, instead of our watching them.

Even the Overhead Club

There is an overhead group which is in a position to affect the over-all plant efficiency; it includes tool designers, layout men, inspectors, engineers, etc. This group receives additional compensation each month which is proportional to the profits earned by the productive men. This brings about a cooperative relationship between productive and nonproductive men, and points this group definitely toward plant efficiency.

Janitors, watchmen, and shippers are earning a profit by keeping the cost of power, coal, water, supplies, maintenance, and their wages below what the cost was for the same volume of business prior to the inauguration of the system. They receive every six months one-half of the saving they make. If outgoing shipments are particularly heavy, it is not uncommon to see janitors assisting in the shipping department.

(Continued on advertising page 58)

This stenographer had no dictation to transcribe, so went immediately to the mailing department and got a supply of envelopes and advertising matter, which she is preparing for mailing. By efficient work, the office employees have made a profit over their wages throughout the depression years

You want to know

and the editors will gladly tell you more about the things mentioned on this page

• TRAINING supervisors and key-men. Report, free, surveys training practices of 85 companies, outlines methods that have been found effective. (1601)

• PAINT in stick form is now available for marking. Hot and cold types. Not a common crayon. (1602)

• SIMPLE processes have been developed for converting sawdust into a molding powder of true plastic properties. (1603)

• TIME RECORDER, portable, carries time control to the job, indoors and out. (1604)

• SOOT can be removed from boiler tubes, flues, and chimneys without manual assistance. A new cleaning powder, applied directly to fires, does it. (1605)

• ALUMINUM pencil, for correcting or marking blueprints, makes clear non-smudging lines that can be erased. It's used like an ordinary lead pencil. (1606)

• AIR HOSE, new, is designed especially to overcome deteriorating effects of hot oil from compressors, can actually be saturated for long periods without going all to pot. (1607)

• MAINTENANCE practices and procedures—a survey that is yours for the asking discusses in detail the organization, operation, and control methods of the maintenance department. (1608)

• LICKING labels should be out for good. Executives of a label concern went into a huddle recently, emerged with a handy dandy moistener. (1609)

• TECHNOLOGICAL changes in relation to women's employment is the title of a bulletin based on experience of 115 concerns. (1610)

• NAME your favorite colors. You can have them all in one pencil, shift at will from, say, black to blue to red to green. (1611)

• EVEN one-armed paper-hangers would have no trouble getting their timecards stamped in the new electric recorder that requires only one hand to operate. (1612)

• NOT NEW but worth looking into is a service that supplies metal stampings in small lots without using standard blanking dies. (1613)

Of silk impregnated with a synthetic resin, the apron she's wearing was designed for lab work, is recommended for any production work where the operator has to dabble in water or chemicals. It's strong and light, waterproof and acid-resisting. (1635)

• NEW SCALE transmits weight electrically to central control station. (1614)

• "DEBASING the Currency" is the title of a free booklet that throws light on (1) what is causing the depression (2) what mussed up prices. (1615)

• THEORY of seeing and lighting is precisely told in a new textbook available at cost of printing. Simple tables eliminate computation, lessen amount of mechanical work involved in illumination problems. (1616)

• TAKE A TRIP through "the most modern arc welder factory in the world," and see if you can't figure out where you might use welding economically. Booklet. (1617)

• MEN responsible for plant upkeep will welcome a little booklet about zinc powder and why it's used in industrial paint. (1618).

• TO COVER plating racks and parts exposed to alkalies and acids, there's a new rubber-like material. (1619)

• FACTS concerning health and safety of women in industry. There's a government report. (1620)

• COMBINED light and record holder for installation on business machines is said to increase production, reduce number of errors. (1621)

• RELATION between illumination and industrial efficiency is the subject of one of a number of recent British lighting reports. Available at nominal cost. (1622)

• DESPITE its general use, the calendar year is not the "natural business year" for most American businesses. Have you heard about this movement? (1623)

• STROBOSCOPE, new, portable, low-priced, finds principal field of application in analysis of rotating and reciprocating apparatus. (1624)

• STAPLER, vest-pocket size, carries 1,000 staples in compact roll, saves reloading time. (1625)

• HIGH-SPEED method of finishing wood enables operator to begin polishing as soon as stain is applied. (1626)

• ENAMELERS' extension course on wheels brings lecturer and sound-slide pictures right into your plant for one, two, three-night stand. (1627)

• MAGNETS of new alloy will lift about 60 times own weight. (1628)

• DUPLICATOR, hand-fed, is designed to meet the requirements of those who do not need automatic-feed and electric-drive equipment. (1629)

• IF WOOL scouring is part of your daily job, be sure to look into the new "frosted" wool process. (1630)

• NICKEL TUBES that pass through a needle's eye are part of the day's work with one manufacturer of tubing. Special orders down to 0.009-in. O.D. have been produced. (1631)

• PUZZOLANIC material, newly developed, reduces soluble salts that cause concrete to deteriorate, increases water-tightness and density by reducing water-cement ratios. (1632)

• PLASTICS—there's a new phenolic material specially developed for high dielectric applications. (1633)

• CARTON — easy-opening, easy-closing type — requires no cutting or perforating. (1634)

We Budget Maintenance —and Control It

A. E. WINDLE
Plant Engineer
Kroger Grocery & Baking Company
Cleveland

OUR COMPANY operates on the 13-period calendar year. Each period consists of four even weeks, and since the year cannot be divided into even quarters by periods, the first, second, and fourth "quarters" consist of three periods each, whereas the third "quarter" includes four periods. All company matters are scheduled and accounted for by periods, quarters, and years, although data for certain purposes are broken down into weeks.

For the maintenance budget the period is the basis for figures as far as accounting is concerned, but the engineer uses weekly figures for his own purposes and for closer control. He also uses these weekly figures to watch more closely the trend of increasing or decreasing costs of certain items as the seasons bring about variations in demand. They are also helpful in reviewing the results after periods of unusually high or low production.

All these figures, assembled and properly correlated, are of value in making up budgets for ensuing periods for the treasurer's department. Each department head submits his budget quarterly in advance.

In a plant where there is little change from year to year, except for normal fluctuations in business volume, it is not hard to make accurate estimates for the budget, allowing for seasonal variations, if any, in the several items. In a plant where constant changes are being made, in products manufactured or in volume, it is more difficult to estimate a budget accurately unless complete data on past performance in the same line are available. But by the proper system of keeping the figures alive and making the constant necessary revisions to suit conditions, it is possible not only to make estimates which will not lead the treasurer astray but also to make it easy to detect any expense that is getting out of line.

In the plant under discussion, budgetary control of maintenance is still in its first year but is taking shape rapidly. Good records of past experience by individual departments were available. Fluctuations in production throughout the year are not wide. Since ours is essentially a bakery and food warehouse plant, there are a few short spurts in the

A November article (page 485) enumerated advantages of budgetary control for maintenance, pointed out pitfalls to be avoided. Now to see how Kroger uses budgeting, gets real control of maintenance costs

MAINTENANCE DAILY TIME REPORT

Name Al Ramsdorfer # 359 Date 9/2/35

Dept.	Description of Work done or Job No.	Start	Finish	Hours
Ware house	Checking coolers	11	12 00	1
B.B.	" "	12	12 30	1/2
B.B.	Oiling bread dept.	12 30	1 30	1
Cake	Oiling cake dept	1 30	2 30	1
Ware house	Rep. banana boxes	2 30	5 00	2 1/2
Ware house	Checking fuse on elevator	5 00	5 30	1/2
Bldg.	Replaced light womens toilet	5 30	6 00	1/2
Salvage	Rep. boiler link	6 30	7 00	1/2
B.B.	Lighting bread oven	7 00	7 30	1/2
				8

Approved: A.E.W.
Plant Engineer

DEPARTMENTAL EXPENSE BUDGET REPORT

Branch Cleveland Department Maintenance Period 193

Name of Account	Previous Period Actual	Current Period Budget	Current Period Actual	Over (Star) or Under Budget This Period	Over (Star) or Under Previous Period Actual
Supervision Salaries					
Non-productive Labor	796	800	794	6	2
Operating & Cleaning Supplies	84	90	96	6★	12★
Perishable Tools	12	15	8	7	4
Oil & Grease Used	18	18	16	2	2
Coal and Gas	404	425	410	15	6★
Repairs to Buildings	53	50	44	6	9
Repairs to Equipment	32	35	37	2★	5★
Telephone & Telegraph	11	12	9	3	2
Heat, Light, Power & Water (Outside)	634	650	642	8	8★
Sundry Hired Service Exp.	2	15	0	15	2
Rearrangement of Plant					
TOTAL VARIABLE EXPENSE	2,046	2,110	2,056	54	10★
Rent		(Fixed)			
Insurance		"			
Taxes, Property		"			
" Other		"			
License Fees		"			
Depreciation, Steam (Power) Plant Equipt.		"			
" Machinery & Equipment		"			

Show Dollars only-Omit cents Remarks

Previous period coal budget was 400.

Figure 2. Time sheets (See Figure 1) are reviewed each day, go to the accounting department weekly. The weekly time is summarized at the end of each period in the Departmental Expense Budget Report which goes to each department head. This is the maintenance department's report

Figure 1. At the bottom of all control is the Daily Time Report which each workman on each shift makes out. Here is an exact record of how Al Ramsdorfer, for instance, put in his time on the Sept. 12 night shift

movement of commodities just at or before several holidays, but these movements have no "long-swing" effect upon maintenance and are absorbed with almost no noticeable effect upon the final figures. And although the character of the output at different seasons varies, the resulting effect upon maintenance expense is localized and does not disturb the plant figures as a whole beyond the range of anticipation.

Avoiding Excessive Paperwork

Although the budget has long been a part of this company's accounting procedure, budgetary control of maintenance work is administered entirely within the engineering department. Its results are of extreme value in making up the advance budgets for accounting purposes.

To facilitate the launching of a closer budgetary control program, we are using only the classification of accounts recognized by the accounting department and set up in accounting procedure. To go further into detail at the start would involve unnecessary clerical work and tend to cloud the picture.

For future reference and for closer control within the engineering department, detailed records are kept of daily work by individual men. This record is made out on a single sheet by each workman on each shift. It could be kept just as well, or in some cases better, by means of time recorders.

One of these sheets is illustrated in Figure 1. It is for a man on a night shift. He is working on jobs planned in advance as well as on routine jobs occurring on his shift.

These sheets are reviewed each day and the times are taken off for engineering department records and future reference. At the end of each week these original time sheets are turned into the accounting department for proper charging of time.

This weekly time goes directly into ledger accounts and is summarized at the end of each period on a sheet called a Departmental Expense Budget Report (see Figure 2) which is sent to each department head by the accounting department. There is never a delay of over one week in getting these reports out.

There may be planning, with or without budgeting; there cannot be budgetary control without planning

Chance to Compare

This report informs the department head how the accounts stands as compared with his estimates. The report shown here is for the maintenance department itself.

It will at once be seen that the daily time sheet, the records taken from it, and a careful scrutiny of the records are the root of the plan.

Men are rotated on shifts so that they are familiar with the duties on each of the eight-hour shifts, become well rounded in experience and therefore more valuable. Each thereby has his full share of the undesirable night shift.

If the records show that an abnormal amount of attention is given to some department or piece of equipment at any time, the reason for it is investigated and analyzed. Surprising things are sometimes found to be the answers in these investigations, and they alone would afford pages of interesting reading. If the demand for attention is subnormal, the same investigation is made. The disclosures from these latter searches are not so varied as with the former and are sometimes encouraging.

To assist in our weekly check as to how our actual results compare with our budget, we use the follow-

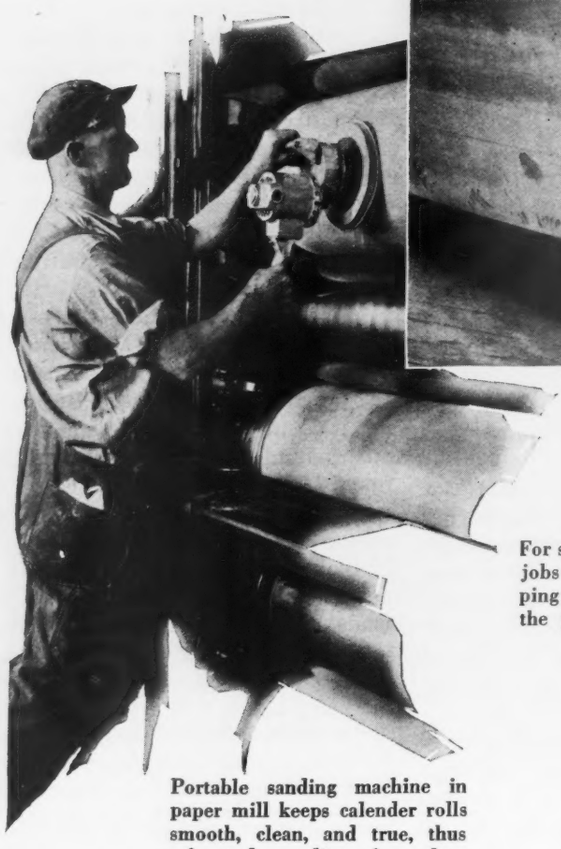
(Continued on advertising page 68)

Power Tools,

To assemble legs on refrigerator, operator uses power drill with special screwdriver attachment

Flexible-shaft tool that turns up from 1,700 to 12,000 r.p.m. at work on a die

In boatbuilding, as in any of the wordworking industries, portable power tools put assembly operations on a production basis. The operator is using a ¼-in. drill



Portable sanding machine in paper mill keeps calender rolls smooth, clean, and true, thus safeguards quality of product

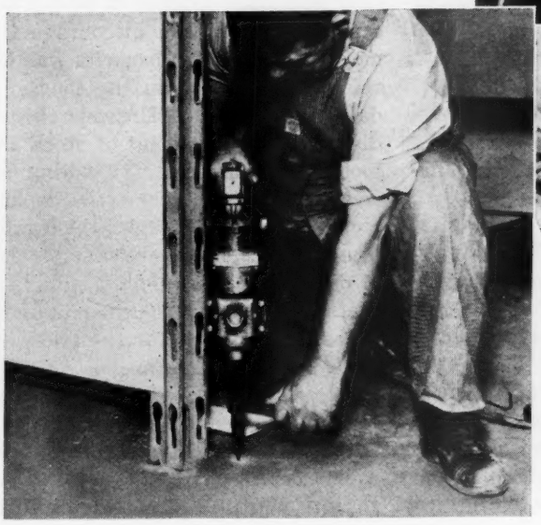
For special packing jobs in the shipping room, there's the power saw

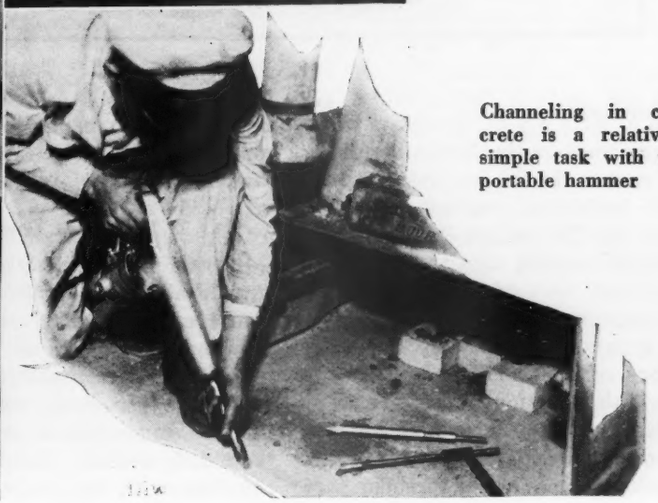
PORTABLE . . .

. . . Are "MUSTS" In Any Plant

Wherever there is sanding of wood, metal, stone, or composition materials, and wherever a fine finish devoid of ripples and ridges is desired, the portable belt sander fills the bill. It is being used here to finish a desk top in a cabinet factory . . . Buhrstones used in grinding mustard are dressed with the portable hammer at the rate of one mill a day and with a reputed saving of $12 a mill . . . Assembly lines in automotive plants depend largely upon portable power tools for the speed they attain. The operator singled out here for attention is setting nuts

Maintenance department gets the word to move partitions. It's not such a job to drill holes in concrete floors where power tools can be taken to the job



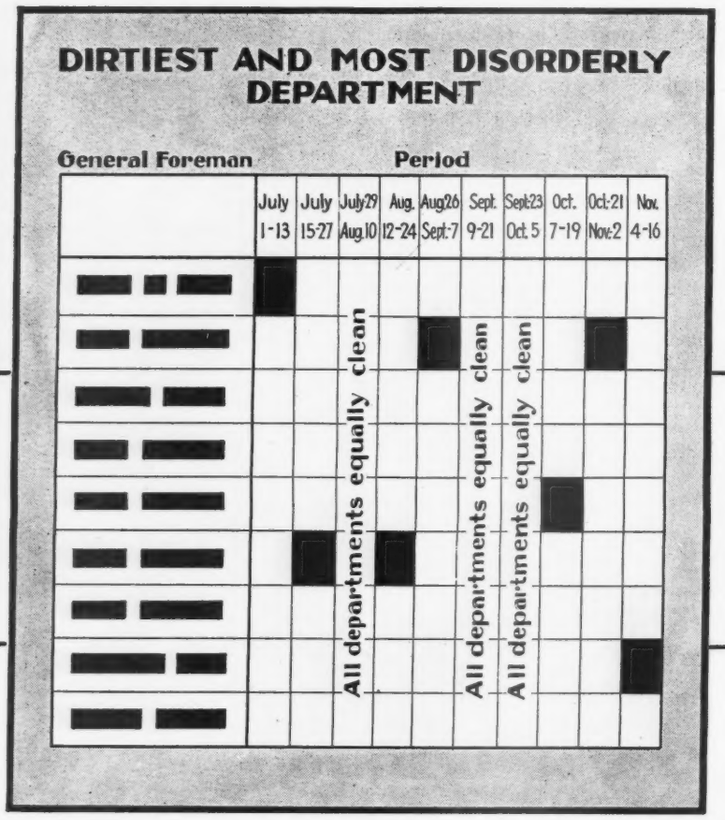


Channeling in concrete is a relatively simple task with the portable hammer

Who's *DIRTY* Now?

Left-handed award to dirtiest department makes workers rally round. Result, cleaner plant

JOSEPH B. HANAN
Staff Superintendent, Mechanical Rubber Goods Division
The B. F. Goodrich Company, Akron



This is the way Goodrich publicizes dirt. To avoid any possible embarrassment, *Factory* has deleted the foremen's names

AS A MEANS of impressing upon workers that a clean, orderly factory is the responsibility of every individual, regardless of his duties, the Mechanical Rubber Goods Division recently instituted a plan which has aroused and maintained employee interest in this problem and resulted in decidedly improved factory conditions.

In this division there are nine general foremen, each of whom has one or more departments under his supervision. These foremen are made directly responsible for the appearance of their respective departments.

No Added Cost

Inspection and rating of the various departments as to order and cleanliness is handled as a regular duty by the Division of Waste Control. This division maintains a corps of three inspectors who make a check of conditions in the course of their daily rounds. Since this work coincides with their regular duties, it was possible to set up an efficient, impartial inspection system at no added cost.

At the end of two-week periods, the department with the *poorest* record is determined. An award for the *best* department was not nearly so effective as the award for the *worst*. Much more effort is expended by foremen and workers to avoid the negative award than to win a positive one.

In the office of the Staff Superintendent is a large and conspicuous chart labeled "Dirtiest and most disorderly department in the Mechanical Division." On this chart are listed the names of the nine general foremen and their department numbers. Opposite the foreman's name, whose department is awarded the title for the two-weeks' period, is placed a large black square. This chart keeps a running record of these awards over a period of several months so that the consistent failure of any one department is immediately noted and the reason determined.

Real care and thought were put into this plan so that it would encourage rather than discourage the men. A system of demerits was developed to be used in the course of daily inspections. Unswept floors, disorderly arrangement of stock and tools, and improper handling of waste all count against the department's record. However, this award is not based on the greatest number of demerits. If all departments keep their total number of demerits under a specified number for the two-week period, no award is made. In other words, the purpose of this plan is to establish certain reasonable standards of cleanliness and order which every department can measure up to with a little concentrated effort.

Motor-Control Troubles

that never should happen

GEORGE H. HALL
Consulting Engineer, New York

WHEN the Big Boss tells the Maintenance Man, "That never should have happened," the latter has to think quickly. If the boss is right, if the trouble really should not have happened, thinking then will not do much good. It should have been done quicker—before the trouble arose. The best work the maintenance crew can do is to foresee potential troubles and prevent them.

In dealing with some classes of apparatus, that is easy. With controllers it seems to be a different matter. There is no reason why it should be so, but controllers give trouble more frequently than do the motors or machines in the average plant. In most instances the troubles should not have happened, but they did. Why? Simply because controllers and starters too often do not receive the thought and care they deserve.

The most fertile sources of controller troubles are incorrect selection, improper installation, and careless operation. Sometimes troubles are due to a combination of all three.

When equipment is purchased, the motor manufacturer cooperates in the selection of the controller, if he does not supply it. The value of his recommendations, however, depends upon his being given complete information on the conditions to be met. Often, after his recommendations have been followed and trouble has arisen, he is justified in saying, "If you had told me the whole story, I'd have recommended something entirely different."

Troubles from such oversights should not happen. A frequent complaint is that the control for a variable-speed slipring motor will not reduce the speed as much as it should. I recall a long day's trip to investigate such a complaint. Motors and controls had been ordered on the basis of horsepower ratings. They were to go on machines, so it was assumed that machine-type controllers would be suitable, but they were not. If a few simple tests had been made before ordering, instead of after installation, the control manufacturer would have been given data showing that entirely different resistors should be supplied. Inconvenience and delay caused by replacement of the resistors would have been avoided. The trouble would not have happened.

But it was a pleasant day's trip —at the customer's expense.

. . . wiring a complicated control with the diagram on the hip invites grief

Not Quickly Enough

In another instance of preventable control trouble, a chemical manufacturer purchased motors and controls entirely suited to his purpose. No trouble occurred for several years. Then he changed his product, and began handling chemicals that gave off flammable vapors.

After a while this manufacturer thought about that—but not quickly enough. I had an appointment to discuss a change to explosion-proof equipment. When I called, the owner was ruefully surveying the charred ruins of his plant.

Sometimes the selection of control devices is influenced by adverse factors that cannot be circumvented. The manufacturer of a peculiar chemical could not get pushbuttons that would stand up. Fumes given off in mixing the materials were not flammable, but they were exceedingly corrosive. The controllers were located outside of the room, away from the fumes, and no trouble was experienced with them. However, all kinds and makes of pushbuttons, regardless of cost, had been tried, but they all gave out within a few months.

This manufacturer was in real trouble. The process was supposed to be continuous. When a pushbutton failed to start the mixing motor, additional batches requiring mixing immediately began piling up. Here was a case where expense and elaborate design had apparently failed. Plenty of thinking had been done, but the right answer had not been found.

"Have you tried a plain, cheap pushbutton with cast-iron case and heavy copper springs?" the manager was asked.

The manager snorted.

"Yes, once. It lasted a little over two months; then it went bad just like the others."

"But it stood the gaff for two months?"

"Yes, it did."

"That's the button to use. It costs less than $2. Replace it every two months, regularly. You can make the change in a few minutes, between batches. Keep a lap ahead of the corrosion and you'll always have a button you can depend on. The cost amounts to about $12 a year, which is no more than the price of a single, more elaborate

button that would not last more than a year, anyway."

The manager agreed that the answer had been found.

Installation of controls offers the finest possible chance for the occurrence of unnecessary troubles, if sufficient thought and care are not

. . . I had an appointment to discuss explosion-proof motors

exercised by the electrician. Practically all controllers are accompanied by wiring diagrams supplied by the manufacturer. The more complicated this diagram, the greater the chances for potential troubles. Actually, however, preventable troubles seem to happen more often with the comparatively simple hook-ups. The answer is—*carelessness.* An electrician who will check and re-check a complicated connection will as often as not make a simple one with little, if any, reference to the diagram.

Too Many Cans

An experienced man connected up the motor and magnetic starter for a can-making machine. It was about the simplest connection possible, except for a start and stop push-button station on each side of the machine. When the connection was completed, the motor was started by pressing one of the start buttons, and everything seemed all right.

The next morning production was started and went smoothly until the delivery mechanism failed to function. The operator pressed the nearest stop button, then the other one, but the machine continued to pile up jammed and spoiled cans until the motor was finally stopped by opening the main switch.

Immediately came the complaint, "Your pushbuttons don't work when more than one is used."

"Why not?"

"That's easy to see. They are supposed to open the holding circuit, but when one is pushed the other still holds the circuit in."

"Did you look at the diagram?"

"Why, no. It seemed so simple that I just connected them the same way I have connected single buttons hundreds of times."

"And you put the stop buttons in parallel, the same as the start buttons?"

"Yes, I guess I did."

A trouble that never should have happened, but that actually did happen. There were only two possible ways to connect the buttons, but the wrong way was followed because the electrician did not think it necessary to check the diagram for anything so simple.

The electrician who is willing to connect up a complicated control from memory, after the diagram has been misplaced and the motor and controller have been relocated, is another member of the host of unnecessary trouble seekers. It would cost a three-cent stamp to secure a new diagram from the manufacturer. Sometimes it costs a good many dollars to rectify the damage caused by an incorrect connection at a controller.

When the Electrician Forgot

Proper location is also a function of proper control installation. A few minutes of brainwork will often prevent many hours of unnecessary footwork.

In a large paint manufacturing plant, thinking in regard to location resulted in placing all the automatic starters in the main mill, which was nearly a quarter of a mile long, on an overhead balcony. If controller trouble did occur, the engineers wanted it to occur in one place. But this attempt to prevent trouble of one kind resulted in entirely unforeseen difficulties of a different variety.

When a controller was cut off the line for inspection, the electrician often forgot to close the line switch when the work was completed. Down at one end of the department an operator would push the button governing this controller, and nothing would happen. Operater and machine then remained unproductive until he walked half the length of the shop, climbed a ladder to the balcony, closed the switch, and walked back again.

This loss in production never should have happened.

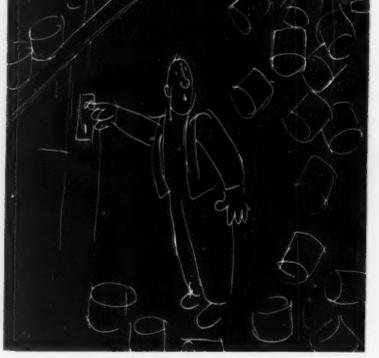
In another case, a pre-considered but improperly worked out attempt to prevent lost motion proved to be just as bad. Desiring to place the control as close as possible to the motor, the electrician mounted line switch and controller on a panel supported by angle irons from the machine base directly back of the motor. Not until it became necessary to remove the rotor did the electrician realize that this could be done only by disconnecting the control panel and removing it from the machine base. Lost time that never should have been lost.

To Prevent Trouble—Look for It

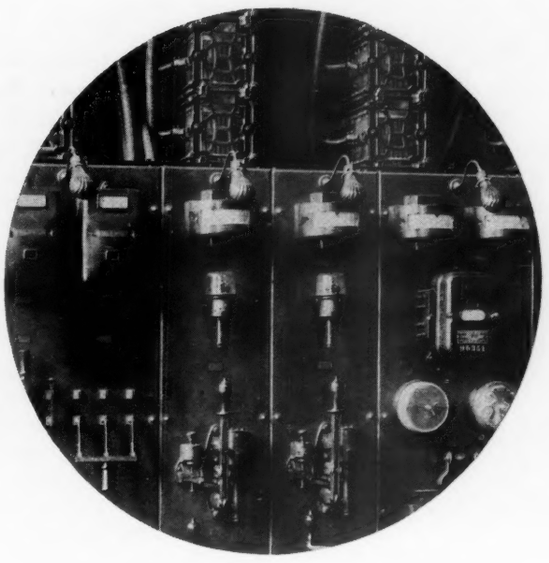
Many troubles that should never occur are due to neglect. Nearly all types of controllers are now furnished with inclosing cases, which protect the operating parts. When the controller is fully inclosed, the tendency is to leave it alone so long as it operates properly. Sooner or later, usually at the most inopportune moment, it fails. Then it is found that the trouble would not have happened if an inspection had been made at regular intervals.

Most controller troubles can be foreseen if they are looked for. Contacts that seem to be working properly may actually be burned and pitted. If such a condition is discovered and remedied promptly, maintenance will have prevented trouble before it happened—which after all, is one of the prime functions of maintenance.

. . . pressed the nearest stop button, then the other one, but the machine continued to pile up jammed and spoiled cans



Be Good to Your INSTRUMENTS



H. A. HENZE
President, Henze Instrument Rebuilders & Repair Company
Hoboken, N. J.

INDUSTRY uses instruments and meters of a wide variety of types and kinds, depends on them to an extent that is not always realized, to control or give indispensable information regarding temperature, pressure and vacuum, flow of liquids and gases, electrical quantities such as voltage, current, and so on. Failure of indicating, recording, or controlling devices to function properly may have serious consequences.

When any such device that is made by a reputable manufacturer leaves the factory, it is safe to assume that it will perform its functions within the limits of accuracy established by the manufacturer or the customer for that type or model. If it is carefully handled and installed under the manufacturer's supervision, or strictly in accordance with the directions, there can be little doubt that it will do just what the manufacturer intended it to do.

Again, assuming that the device was properly selected, which usually means that the manufacturer was given complete information about the conditions and requirements, the chances are that it will satisfactorily perform its functions in the owner's plant for a long time.

Not According to the Book

Unhappily, things do not always work out so nicely. There are a number of places where errors of one sort or another can be made in the chain of events that begin to happen between the time that a decision is made to purchase a meter or instrument and its eventual removal from service. Any one of a number of things, ranging from improper selection to downright abuse, may be done that will seriously affect the operation of the device.

Selection of meters and instruments is an important matter that can not be discussed in detail here. It will not come amiss, however, to point out that close cooperation with the manufacturer will do much to prevent costly mistakes and insure satisfactory service. For example, it is important to give full consideration to all conditions that may affect the accuracy or functioning of the device. Location; atmospheric conditions, particularly as regards the presence of excessive moisture, steam, or corrosive gases; likelihood of sudden, violent fluctuations that may exceed the capacity of the instrument—all must be considered.

Incidentally, it is advisable, particularly with pressure gages, to select one whose capacity is well above the average maximum value of the quantity to be measured. If this is done the chances are that the readings will be more accurate and there will be some reserve capacity to handle readings above the average value.

Recently we saw a 100-lb. pressure gage with the pointer at the end of the scale. No one knew what the pressure was.

When Instruments Are Relocated

Oftentimes it is important to consider the accuracy required of a meter or instrument. For some purposes high accuracy may be imperative; in others a reasonable error may be quite permissible. In general, the higher the accuracy of an instrument, the higher the price. There is little point in paying a premium for a higher accuracy than needed.

All of this boils down to the matter of properly fitting the device to the function it is to perform, and the operating conditions.

On the whole the meters and instruments on which industry is dependent for vital information perform their tasks with surprising dependability and accuracy. In those instances where this is not strictly true the cause may lie in any one of several directions. Certainly, improper installation is a very prolific source of trouble. It was said above that when these devices are installed under the supervision or directions of the maker it is safe to assume that it has been done properly.

In many instances, however, the manufacturer has little or nothing to do with the installation. Furthermore, it is not unusual for instruments to be taken down and relocated, or retired from service for a

while and then put back. This important job may be, often is, intrusted to mechanics who have little knowledge of and perhaps less regard for such delicate mechanisms. Then the results may be weird.

Or, it sometimes happens that an executive or technician who ought to know better will assume that because an instrument has given satisfactory service in a certain application it will serve just as well anywhere else, and therefore puts it to work under totally different conditions. Results often show that such assumptions are not warranted.

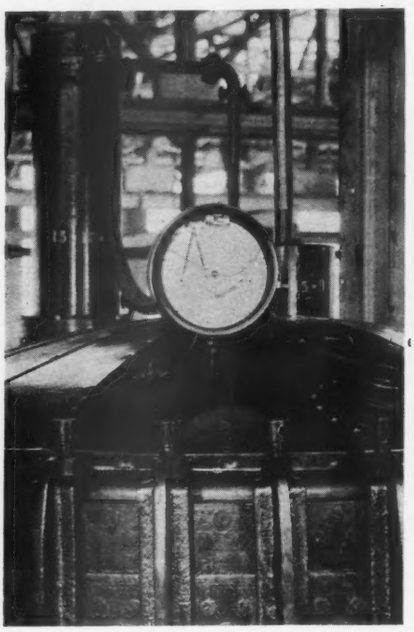
Fragile—Handle with Care

Much trouble comes from failure to realize that instruments and meters are very delicate mechanisms and must always be handled accordingly. Designers make them as rugged as possible, but it is easy to see that the extreme necessity of reducing friction to the lowest possible amount means the use of light, delicate parts, fine bearings, and hard but brittle jewels. Hence, a fall or rough handling may cause more damage than is apparent. Instruments should not be left to the mercy of heavy-handed mechanics.

When they are designed to be mounted on a board, care must be taken to see that the holes are spaced properly and that the surface on which the instrument is mounted is plumb and true. Forcing an instrument to conform to an uneven surface will almost certainly spring the frame and place working mechanisms under a stress that may put them out of commission. The forces that actuate pointers and pens are usually of very small magnitude; therefore, any increase in friction is likely to be serious.

Pressure gages are about as rugged and simple as any of the commonly used measuring devices; nevertheless, it is easily possible to injure them. It is common practice, particularly when reinstalling a gage, to screw it tight in the line and then push the gage back against the board. Doing this strains the inside mounting of the socket, and is likely to disturb the calibration.

Instruments and meters for temperature, pressure, and so on differ so much in construction and principle of operation that it is not possible to consider all of the points that must be observed when installing them. Anyway, when such information is needed it can always be obtained from the manufacturer. Nevertheless, it may be helpful to point out some of the things that



should *not* be done. They are some of the causes of trouble that we have found when called into various plants for advice.

In one plant a recording thermometer had been taken out for repairs and another substituted for it. The replacement instrument was designed to have the bulb installed below the head. Instead, it had been put in with the bulb elevated between 20 and 30 ft. above the instrument.

Gaily Swinging To and Fro

Investigation of a complaint that a recording thermometer was not functioning properly disclosed that it had been suspended by a piece of wire from an overhead pipe. There we found it, gaily swinging to and fro. Apparently not everyone knows that stationary-type instruments should be firmly mounted on a rigid support.

Instruments that were not properly sealed have been found exposed to acid fumes or excessive moisture. Never forget that rust and acid corrosion can quickly play havoc with the finest instrument.

Almost as bad is the rather common failure to replace broken or loose glasses at once. Even under ordinary shop conditions enough dust, perhaps moisture, can seep in to cause serious trouble.

In another plant the bulb of a distant-reading thermometer for indicating the outdoor temperature was installed on the outside of a piece of tin that replaced a window pane. Heat radiation from the tin caused an error of 14 deg. in the reading of the thermometer.

Again, we found that a distant-reading thermometer had been installed with the mercury tubing running alongside a steam pipe. Of course, the heat from the pipe seriously affected the accuracy of the reading.

The reason why a thermometer did not, according to the complaint, correctly indicate the temperature of the liquid in a tank was found to be that the bulb was screwed into a dead pocket around which the liquid did not circulate.

Another very common and very important reason why instruments and meters fail to function with the accuracy and dependability they once had is neglect to have them overhauled and calibrated occasionally. Wear of parts, changes in the physical structure of certain elements, entrance of dirt or moisture, and various other conditions all combine to impair the accuracy of any instrument.

Check Up Frequently

There is no hard-and-fast rule about it, but it is advisable to check the accuracy of all instruments and meters, electrical and otherwise, three or four times a year: oftener if the service is very important or there is reason to suspect that the equipment is not functioning properly. In general, it is well to check temperature indicating, recording, and controlling instruments at more frequent intervals.

Desirable frequency of overhauling also varies with the kind of equipment and the service conditions. When check tests show an undesirable lack of accuracy the instrument should be recalibrated at once. When this is done it is frequently advisable to go over the instrument very carefully and make any adjustments or repairs needed.

BUILDINGS ALWAYS in SHAPE

Being on-the-job with repairs keeps this plant in shape. Continuous inspection, centralized responsibility, minimum of red tape help, too

E. L. TANNER
Plant Engineer
Mergenthaler Linotype Company, Brooklyn

ALTHOUGH there is value in systematic reporting and recording of maintenance activities, we have worked to minimize the amount of red tape necessary to carry on our building maintenance. We have substituted close supervision and centralized responsibility for an ultra-complete history of work done and an exacting control routine. Good housekeeping, without spending too much time putting it on paper, has been our objective in plant maintenance.

Several recognized practices guide our work. To start with, we budget maintenance. Daily inspection gives a continuous check-up. Responsibility is centralized in the plant engineer who maintains close supervision of all work in progress. By constant attention to the little things, we keep things shipshape. Underlying it all, however, is a policy of education which instills into each employee a sense of responsibility for the plant's condition. It aims to train him to keep his machine and workplace clean and in order, and to report any need for repairs that he may discover.

Budgeted maintenance keeps our costs in line. Our ability to operate within the budget and keep plant in first-class condition testifies to our success in doing our job without detailed records. This is done under a management that is particularly anxious to maintain a well-kept plant and has approved liberal maintenance budgets.

Only two forms are used by the plant engineer's office. One is a request, made out by departmental foremen, for construction or repair work. If the job can be done for less than ten dollars, the request goes directly to the maintenance foreman whose department must do the job. If expenditure of more than ten dollars is required, the request must go to the plant engineer for his approval and for preparation of a factory expense order.

The original of this order goes to the works accounting department; the duplicate remains in the plant engineer's office. Additional copies are made for each department having a share in the work. The duplicate copy is filed in the engineer's office as a record of the job and as a basis for estimates on later jobs.

Floors in this automatic screw machinery department get a scrubbing every ten days. Paint on the ceiling is five years old, but is still bright

Continuous Inspection

Inspection and check-up go on continuously. Cooperation between plant engineering and plant protection departments has brought about the filing of a daily report by each watchman, in which are noted any parts of the plant that are out of order and needing attention. A leak, a broken window, or even a broken window chain will be mentioned. Since the plant protection department operates separately from the plant engineering department, a written memo is sent by the protection squad captain to the engineer.

Reporting to the plant engineer

(Continued on advertising page 52)

Oil's Not "Just

. . . and then they wondered why the turbine wouldn't run

A plea for more hoss sense that has obscured since the days when, after

AMONG the most important factors in the great advancement in invention, design, and manufacture of machinery over the past forty years or so has been the availability of suitable lubricants. Much of the machinery in use today could not be lubricated with the materials available even ten years ago.

Nevertheless, plants do have lubrication troubles, and many of them could be prevented if those responsible for plant operation would get rid of some of the fallacies regarding lubricants and lubrication.

Plant superintendents, master mechanics, and others responsible for lubrication can, it seems to me, be divided into four general classes.

First there is the man who knows something about the lubrication requirements of his machines, understands why different lubricants may be expected to function differently, and accepts experienced advice.

In the second class is the man who has made some study of lubricants and writes specifications for the supplier. The third makes no attempt to study lubricants and blames them for every trouble from a leaking steam main to a clogged water pump intake.

Finally, we come to the man who knows nothing about lubricants, considers that "oil is oil," and probably is perfectly satisfied with the lubricants his father used.

From the standpoint of lubrication efficiency, it is safe to assume that the plants of those men rate in the order named.

Men in the first group have found that failure of a machine to operate properly or to show reasonable upkeep expense cannot always be traced to the lubricants used. They know that there is a correct lubricant for every requirement, that someone must select it, and that correct application is important. These men may buy on specification to a limited extent, but they realize that it is a fallacy to believe a certain requirement can be met by only one lubricant.

Viscosity First

By conferring with the representatives of reputable lubricant manufacturers, they learn something about lubricants and how they function under given conditions. They learn that when lubricating any bearing the viscosity (body) of the oil must receive first consideration. If too "light," it will not stay on bearing surfaces long enough to lubricate them; if too "heavy," it will not reach those surfaces. There is a direct relation between size of shaft, speed of shaft, and bearing clearances. Bearings of a large, slow-moving shaft require a heavy-bodied lubricant and *vice versa*. This is a law, and oil quality, either good or bad, cannot change it.

A bearing may, of course, be incorporated in a machine such as a steam turbine where the conditions make it necessary to consider one or more of the other physical characteristics of the oil.

Again, the men in the first group know their plant equipment and keep it in good condition because they know poorly kept machinery cannot be operated advantageously, even with expensive oils. At the same time they know good lubricants help keep equipment in good shape.

The men in the second group usually succeed only in making things difficult for themselves. They believe that specifications are the ultimate answer to the demand for satisfactory results, not knowing that specifications in themselves mean little because it is impossible to define many of the inherent qualities of a lubricant.

These men seem to feel that they alone know how to diagnose lubrication requirements and prescribe the oil, totally ignoring the fact that any reputable manufacturer has ready-made, branded products to fit all except very special and infrequent cases. Actually a plant can be successfully lubricated with surprisingly few kinds of oil. So, unless the manufacturer has a regularly branded product which meets a specification, he has to make one.

Such men usually have well-lubricated plants, but they accomplish that result with much trouble to themselves and the suppliers. Unless a very large plant is involved where the expense of a lubrication engineer is justified, their lubrication costs must be high.

Plants operated by men of the third group actually have many troubles, for some of which lubrication may be indirectly responsible. More of the troubles are purely imaginary; most are the result of the fallacy that lubricating products can replace worn-away metal and compensate for a designer's failure to provide suitable lubrication.

These men usually believe in operating a machine without adequate repairs just as long as it will turn over; if it fails to do good work, that

Oil" Any More

LEWIS K. URQUHART
Associate Editor

must be because it has been supplied with worthless lubricants. When a bearing becomes so worn that something must be done, they use a heavier oil, which is permissible within very narrow limits, but is only a makeshift. If that action is criticized, they retort that since the bearing was lubricated it should not show wear. Apparently they believe that the presence of lubricant guarantees the elimination of all friction, whereas perfect lubrication in the fullest sense of the word is impossible to accomplish.

When a bearing burns out, they immedately say, "So-and-So's oil did it," whereas at no time has any unadulterated lubricating oil, no matter how imperfectly manufactured, caused a burned-out bearing. Honest investigation will always show that the trouble was caused by the oil not reaching the bearing, or because it was contaminated with grit or moisture, or because the bearing itself was so worn that no oil could prevent it from pounding out.

Failure to keep the plant equipment in proper repair accounts for many imaginary lubrication troubles.

sense and less of the non-lubricating practice ever all, oil *was* "just oil"

Men of this third group pay little attention to the physical characteristics of lubricants or to how any certain type may be expected to function under given conditions. Inclined to listen and believe many things about lubricants without fully understanding them, they often try to do the impossible.

For example, an excellent master mechanic was found trying to cool an already hot bearing by flooding it with a very heavy oil. Apparently he thought that there was more "lubrication" in the heavy oil, forgetting that since bearing clearances decrease with temperature increase there was little chance for the heavy oil to get in.

This same man burned out an exhaust fan bearing because he did not ascertain the temperature at which a certain oil ceased to flow. The fan bearing was exposed to winter temperature. Because the shaft speed was high and the bearing important, he used steam turbine oil, naturally of high quality. The oil was warm when applied, but with 30 deg. F. pour test, it is obvious what happened in a zero temperature.

Good Old Feel Test

To men in the fourth group, "oil is oil" regardless of origin or purpose. They make no effort to standardize lubrication and always purchase on the basis of lowest cost per gallon. They have lubrication troubles but accept them as a matter of course, because they cling to the fallacy that properly manufactured, intelligently recommended, and correctly applied lubricants do *not* reduce lubrication costs.

These men believe they can test the quality of an oil simply by looking at it, or feeling it, although experienced lubrication engineers will balk at even attempting to judge an oil in these ways. When by any chance they do purchase a suitable product for some important job, they make no effort to prevent contamination. In several instances where a steam turbine gave trouble for which only the lubricant could be held accountable, it was found that the same pail used to convey cylinder oil was used without cleaning to carry make-up oil for the turbine system. The animal oil compound in the steam cylinder oil caused the turbine oil to emulsify and thicken so that it failed to reach the turbine bearings.

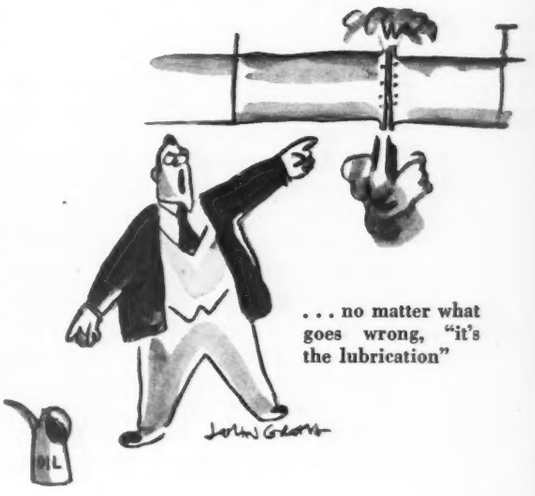
In many plants lubricants are classed as a necessary evil—something that cannot be dispensed with but which at any moment may fail to function, thereby causing both mental and physical anguish. This feeling is not justified, but undoubtedly will exist until plant operators and executives learn more about their own plant equipment from a lubrication standpoint, and become familiar with the inherent characteristics of lubricants.

Better knowledge of lubricants will eliminate many of the fallacies that have persisted since when, possibly, "oil *was* oil." The larger petroleum product manufacturers spend millions of dollars annually in improving their product. Lubricating products of today are so much better than those of a few years ago that there is no comparison.

In order to combat friction successfully, a precise knowledge of both machine and lubricant is desirable. There is nothing mysterious about the way an oil keeps frictional surfaces apart; even a common-sense knowledge of lubricants and mechanical equipment will prevent many machine failures.

In general, it is best to use good-quality lubricants because they will give a greater return per dollar invested, but there are applications, such as heavy, rough bearing lubrication, where a high-quality product will give no better lubrication and last no longer than a much cheaper product. In situations of this kind the services of a lubrication engineer are of real value.

It is not possible to give plant executives a general guide that will enable them to eliminate all lubrication troubles, but they can materially improve matters if they will avoid taking too much for granted, put common sense into their handling of lubrication, and forget many of the "beliefs" that are more detrimental than lack of knowledge.



. . . no matter what goes wrong, "it's the lubrication"

A.C. Wave Windings

Use of tables and connecting diagrams for windings that have four slots per pole per phase is clearly illustrated by an example

A. C. ROE

WITH this article are presented the connecting diagram (Figure 5), Connecting Table V, and Checking Chart V, for windings having four slots per pole per phase. Checking the slot and pole combinations given in Connecting Table V will show that the connecting diagrams in Figure 5 will be very useful, since these combinations are widely used.

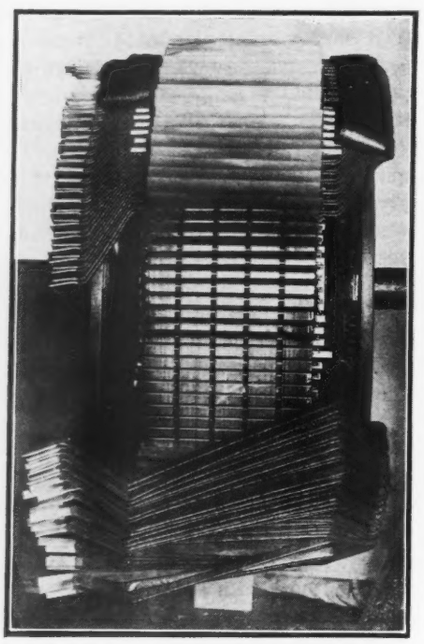


Figure 1. Winding for a 12-pole, 144-slot, three-phase rotor. There are four slots per pole per phase. Back pitch is 1 and 13

In the preceding article the various pitches applying to a.c. wave windings were discussed, and rules were given to show how the pitches for any winding should be figured. This article will consider the pitches as applied to any winding.

The absence of any pitch data from the connecting diagrams in this series will be noticed. By referring to Figure 5 it will be noted that the only marking of the slots in each sketch representing a phase section is to indicate the general location of the *1*, ***, *3* and *4* leads of each phase.

This omission of the actual slot representation in the connecting diagrams contributes to their simplicity, as will be explained in the following: Referring to Figure 5 and the A-phase sketch, if the diagrams were made to show the actual number of slots spanned the space between slots *X* and *O* over *SP1* would have to contain twelve more slots. The same thing holds for the space over *SP2*.

From the foregoing it is obvious that in Figure 5 each phase sketch would require 16x2 = 32 more lines to indicate the top and bottom conductors in the slots, between slots *X* and *O* and the space over *SP2*. For eight slots per pole per phase, the last diagram of the series, 32 × 2 = 64 more lines would be required.

By omitting these slots a small space can be used to indicate that fact, and reference to the checking table for each connecting diagram will show at a glance the number of slots omitted. For example, consider Figure 5. Checking Chart V for this diagram shows twelve slots in each horizontal line, or twelve slots per pole; hence the space between slots *X* and *O* should have 12 — 4 = 8 slots.

Checking the Number of Slots

Another check on the number of slots in the space over *SP1*, *SP2*, *SP3*, and so on is that there should be twice the number of slots per pole per phase. This statement holds true for both odd and even coil

Checking Chart V*

Four Slots per Pole per Phase

No. of Slots	No. of Poles	Polarity	Phases C				B				A			
		↑	9	8	7	6	5	4	3	2	1	Z	Y	X
48	4	↓	21	20	19	18	17	16	15	14	13	12	11	10
		↑	33	32	31	30	29	28	27	26	25	24	23	22
		↓	45	44	43	42	41	40	39	38	37	36	35	34
72	6	↑	57	56	55	54	53	52	51	50	49	48	47	46
		↓	69	68	67	66	65	64	63	62	61	60	59	58
96	8	↑	81	80	79	78	77	76	75	74	73	72	71	70
		↓	93	92	91	90	89	88	87	86	85	84	83	82
120	10	↑	105	104	103	102	101	100	99	98	97	96	95	94
		↓	117	116	115	114	113	112	111	110	109	108	107	106
144	12	↑	129	128	127	126	125	124	123	122	121	120	119	118
		↓	141	140	139	138	137	136	135	134	133	132	131	130
168	14	↑	153	152	151	150	149	148	147	146	145	144	143	142
		↓	165	164	163	162	161	160	159	158	157	156	155	154
192	16	↑	177	176	175	174	173	172	171	170	169	168	167	166
		↓	189	188	187	186	185	184	183	182	181	180	179	178
216	18	↑	201	200	199	198	197	196	195	194	193	192	191	190
		↓	213	212	211	210	209	208	207	206	205	204	203	202
240	20	↑	225	224	223	222	221	220	219	218	217	216	215	214
		↓	237	236	235	234	233	232	231	230	229	228	227	226
264	22	↑	249	248	247	246	245	244	243	242	241	240	239	238
		↓	261	260	259	258	257	256	255	254	253	252	251	250
288	24	↑	273	272	271	270	269	268	267	266	265	264	263	262
		↓	285	284	283	282	281	280	279	278	277	276	275	274

***To be used with Figure 5 and Connecting Table V.**

grouping. For example, reference to Figure 4 and Checking Chart IV in the preceding article (December issue) for $3\frac{1}{2}$ slots per pole per phase, will show seven slots ($2x3\frac{1}{2}$) between the slots forming the space over the short pitch (*SP*) sections

The partly wound rotor shown here in Figure 1 will also help to explain why the slots can be omitted in the connecting diagrams without causing any confusion. This winding is for a 12-pole, 144-slot, three-phase rotor with a back pitch of 1 and 13. So far as winding is conconcerned, the coil itself and the given back pitch insure all coils being installed properly.

Therefore, all that is required of the connecting diagram is that it show the slot numbers in their location, for all the leads and short-pitch leads. Let us see how this works out in the case of the winding which Figure 1 shows.

Since this winding has four slots per pole per phase, we use Figure 5 and Connecting Table V, the 12-pole line. It will be seen from Figure 1 that there are four conductors per slot, two conductors in parallel, or the two straps of each coil are considered as one single coil.

Twelve Leads to Pick Out

The straps are all insulated alike; that is, there are no phase coils, and the conductors are not heavy enough to warrant the use of special, short-lead coils. Therefore, all we need to start the winding is the back pitch, which is given in both Figure 5 and Connecting Table V. The winding can be started in any slot, since all of the coils are alike in every respect, and no further data are needed until all coils are in.

After all of the coils are in place twelve leads must be picked out. The first step is to determine where the connections for the *A1*, *B1*, and *C1* leads to the collector rings are to be located. If they are 120 deg. apart we can use Connecting Table V, which shows that the leads are located in the bottom of slots *1*, *113*, and *57*. It will also be seen that the *A**, *B**, and *C** leads are located in the bottom of slots *133*, *101* and *45*.

Checking Leads with Test Light

These slots can be located and marked on the core with chalk, but only the ends of the coils are visible. In order to locate the proper lead a test light is used as follows: To any of the slot numbers required add the back pitch and count to the left the number of slots. This procedure will locate the top half of the lead wanted; then, holding the test light on the top lead, find the bottom lead that lights.

The slots can be marked before starting to wind, and the bottom leads marked as coils are wound in.

Next, the top leads *A3*, *A4*, *B3*, *B4*, *C3*, and *C4* are located in the tops of slots *130*, *118*, *98*, *86*, *42*, and *30*, respectively. Thus all of the 12 leads are marked.

Again, from the diagrams in Figure 5 and from Connecting Table V we find the three *SP* connections. It will be seen from Figure 5 that the three top leads to the left of the *A3*, *A4*, *B3*, *B4*, *C3*, and *C4* leads connect to the three leads, in sequence, to the right of the *A1*, *A**, *B1*, *B**, *C1*, and *C** leads. Put clips on these short-pitch leads.

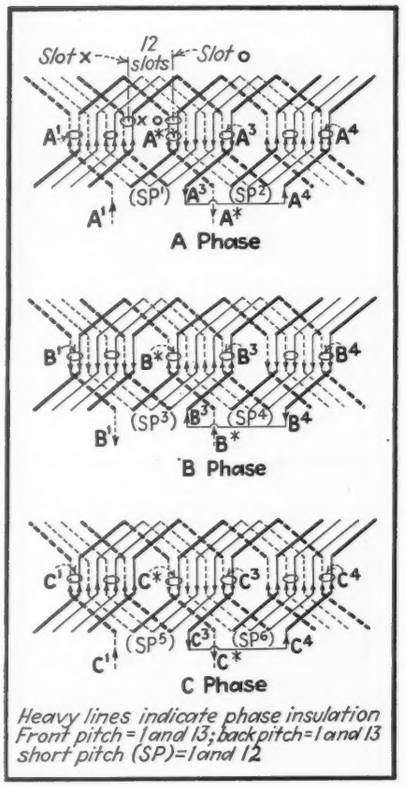

Slot x
12 slots
Slot o
A Phase
B Phase
C Phase
Heavy lines indicate phase insulation
Front pitch = 1 and 13; back pitch = 1 and 13
short pitch (SP) = 1 and 12

Figure 5. Connecting diagrams for a.c. wave windings having four slots per pole per phase. These diagrams are to b eused with Conecting Table V

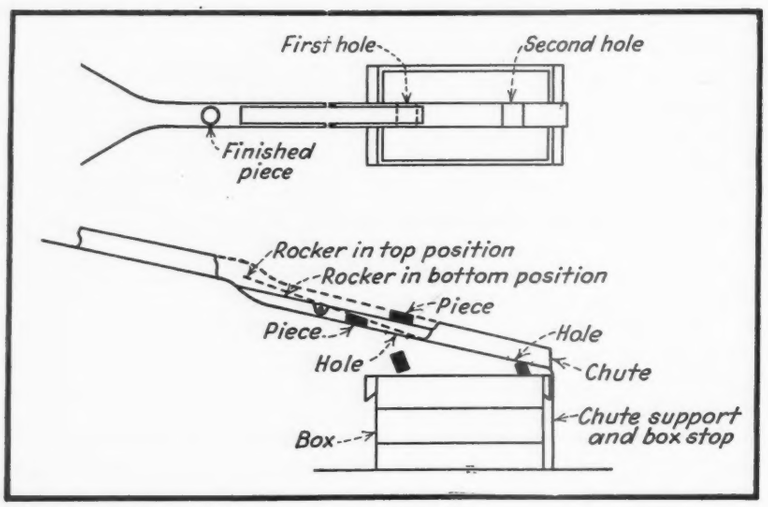
A succeeding article, which will appear in an early issue, will discuss the diagrams for $4\frac{1}{2}$ slots per pole per phase, with points to be watched when winding a.c. rotors.

Connecting Table V*
Four Slots per Pole per Phase

No. of Poles	No. of Slots	A Phase Bottom Leads A1	A*	Top Leads A3	A4	B Phase Bottom Leads B1	B*	Top Leads B3	B4	C Phase Bottom Leads C1	C*	Top Leads C3	C4	Short Pitch Connections SP 1–3–5	SP 2–4–6
4	48	↑ 1	37	34	22	↓ 17	5	2	38	↑ 33	21	18	6	3	3
6	72	↑ 1	61	58	46	↓ 17	5	2	62	↑ 57	45	42	30	3	3
8	96	↑ 1	85	82	70	↓ 65	53	50	38	↑ 33	21	18	6	3	3
10	120	↑ 1	109	106	94	↓ 41	29	26	14	↑ 81	69	66	54	3	3
12	144	↑ 1	133	130	118	↓ 113	101	98	86	↑ 57	45	42	30	3	3
14	168	↑ 1	157	154	142	↓ 113	101	98	86	↑ 57	45	42	30	3	3
16	192	↑ 1	181	178	166	↓ 65	53	50	38	↑ 129	117	114	102	3	3
18	216	↑ 1	205	202	190	↓ 65	53	50	38	↑ 153	141	138	126	3	3
20	240	↑ 1	229	226	214	↓ 161	149	146	134	↑ 81	69	66	54	3	3
22	264	↑ 1	253	250	238	↓ 89	77	74	62	↑ 177	165	162	150	3	3
24	288	↑ 1	277	274	262	↓ 113	101	98	86	↑ 201	189	186	174	3	3

***See Figure 5 for connecting layout.** **Front and back pitches = 1 and 13.** **Short pitch (SP) = 1 and 12.**

Operating Shorts



Rocker Chute to Fill Box Evenly

H. MOORE, *Hamilton, Ont., Canada*

The work sliding down the chute from an automatic screw machine piled up in the box and overflowed before the box was filled, so a new chute was made to fill the box at both ends.

This was made of sheet metal with upturned sides and the end bent over to touch the floor and thus support the chute and form a locating stop for the box. Instead of being straight, the chute takes a dip and the rocker, also sheet metal, is pivoted. In one position, one end of the rocker rests on the incline just below the dip, while in the other position the other end of the rocker rests on the bottom of the chute.

As a finished piece slides down the chute, the rocker may be in the bottom position with the end resting on the incline below the dip. It slides along the rocker until it reaches the far side of the pivot when its weight presses the rocker down. Then, sliding on until it reaches the second hole, it drops into the box. The rocker is now in the top position so the next piece sliding down passes beneath it until it, too, reaches the far side of the pivot when it pushes up the rocker and drops through the first hole. The rocker must work, not free, but just stiff enough to be moved by the weight of the piece.

Mr. Moore's contribution has been awarded the $10 payment offered by the editors for the best Operating Short submitted during the past month.

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Unconventional Layout Has Advantages

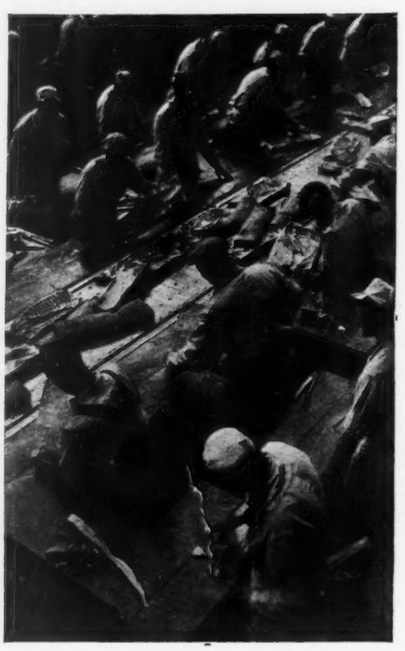
SOURCE, *George A. Hormel & Company Austin, Minn.*

The profit sometimes to be obtained by upsetting a tradition is beautifully demonstrated in a small item of layout in this plant's new hog-cutting floor. And while specific details of the method are strictly those of a packing plant, there should be in the idea a suggestion for other types of manufacturing not remotely connected with meats.

The method universally followed in packing plant design hitherto has been to provide at each knifeman's station—if he trims off pieces too small for major cuts—a chute leading to the floor below. These small trimmings are deposited on a table before a man whose job is complexly known as that of a trimmings trimmer. This latter man cuts apart the bits into fat and lean. The lean then goes to the sausage department, while the fat goes to the tank room for rendering into lard.

In the new layout, the trimmings trimmer stands at a small table, directly connected with the main cutting table, which is squarely behind the knifeman. Instead of pushing his trimmings into the chute, the knifeman pushes them behind him, where the trimmer gets to work on them. The trimmer shoves the fat through one hole in his table, the lean through another hole. Beneath each hole is a galvanized pail. A couple of laborers go through the department rolling large galvanized cans, like waste cans, and stop behind each trimmer long enough to empty his pail into the can. When the large can is full, the laborer rolls it to the proper one of the two large chutes at the end of the room, one for lean and the other for fat. He dumps the can, and the meat goes to the floor below.

The work of collecting the pieces



is no greater when it is done on the cutting floor than as it was formerly done on the lower floor. Instead of perhaps 40 chutes, the upper floor has only the two, which means a decided saving in investment and an even greater ultimate saving through having to wash up only two chutes a day after work is over. Moreover, the trimmings trimmers require a great deal less floor space than they required when on the lower floor, each with a large table on which trimmings accumulated.

The largest saving, however, is not superficially apparent. Fresh meat is perishable, and previously if ever the trimmer on the lower floor fell behind with his work, the pork which accumulated at the bottom of the pile remained there on the table all day, the last to be trimmed when he was finishing up. Now it is separated instantly into lean and fat, never accumulates, has no chance to become stale or lose color. Instead, the pieces are chuted down to the lower floor already separated. The fat goes straight to the tanks. The lean has a final sorting to eliminate inedible bits, if any, but this is done so fast that it has no chance to pile up.

Painting corners white as an aid to cleanliness worked well in one plant until chewing-tobacco sharpshooters discovered the white circles made good targets. So a flock of cuspidors.

Mark Pipes With Painted Metal Bands

MARK BELL, *Passaic, N. J.*

In some of the largest and most up-to-date plants it is customary to differentiate between pipe lines by painting them in distinguishing colors. In the interests of safety it is advisable to do this, even though maintenance men may be certain that they know all the lines.

In smaller plants where cost is a barrier to painting all lines, it is possible to mark pipes with little labor and cost. Cut a number of metal bands about two inches wide and a little longer than the circumferences of the pipes. The bands may be of any material, and after having been bent into collars, should be clipped over the pipes, and held in place by small bolts inserted through holes drilled in the bent-out overlaps of the collar. Paint bands in colors different from the pipes, and in still other colors stencil along the circumferences necessary designations.

Place bands around pipes in each section and on each floor. See to it that the markings can be easily read from the floor. They will look neat and prove a convenience for everyone.

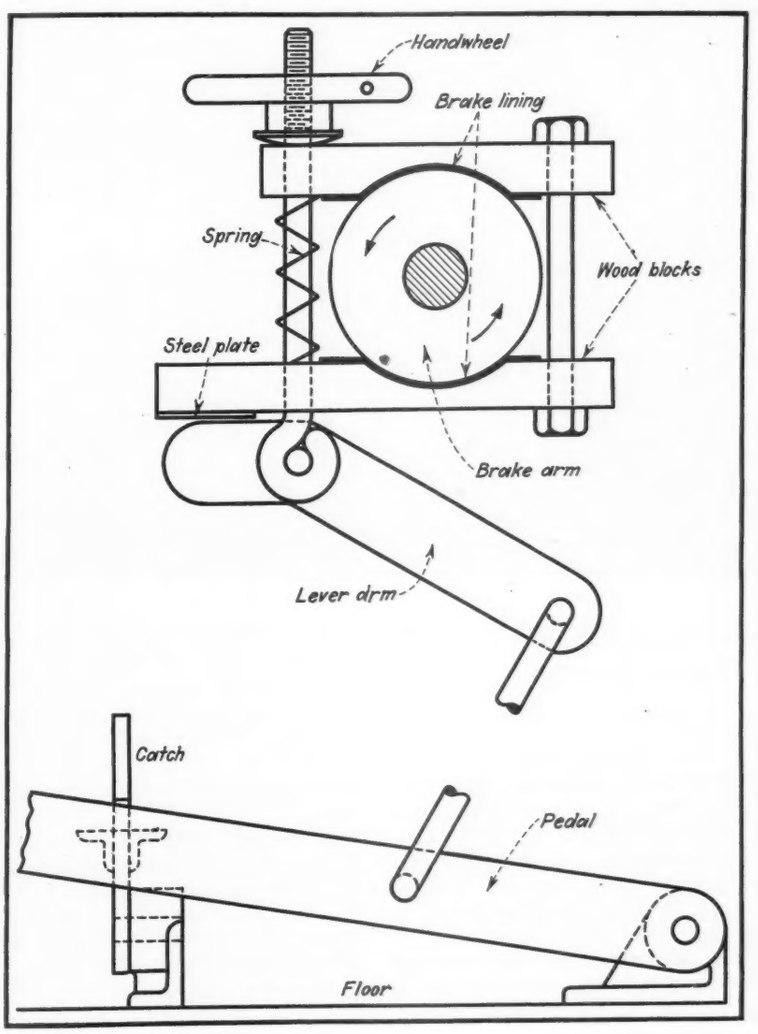
•

Slipping Brake Maintains Load, Controls Speed

R. A. PERRETT, *Oak Park, Ill.*

We use a d.c. motor to drive one of our winding machines, because of the need for a variable-speed drive. The generator that furnishes power for this machine, furnishes power for two other machines in other departments. All three machines should be operated on 230 volts, but because of the starting speed requirements of the winding machine, the voltage was lowered to about 130 volts. This caused the speeds of the machines in the other departments to fluctuate, depending upon whether the winding machine was operating or not. If the voltage were to be set up to 230 volts, the speeds of these machines would remain constant, but the winding machine would start up too fast. To overcome these conditions properly, would require the installation of additional expensive electrical equipment.

The speed of the winding machine's motor was electrically controlled through the rotor. This means that the speed of the machine varied, depending upon the load that it pulled. In view of this fact, it was decided to let the present electrical equipment stand, and to install on the winding shaft of the machine a brake that would supply enough additional load for the motor to pull, when voltage was set up to 230 volts, to enable the machine to continue to operate at the required slow speed when starting the wind-



ing operation. The brake could be released then, and the machine speeded up.

The brake that was used is shown in the sketch. It was made up of two maple wood blocks cut to desired size and shape so that a brake lining could be fastened to them. An eyebolt was put through one end of the blocks, the eye forming a hinge for a lever arm. On the other end of the eyebolt were placed a washer and hand wheel. The other ends of the wood blocks were held together by a bolt. The lever was linked to a foot pedal. When this pedal was depressed a catch held it down. The brake drum was mounted on the winding shaft of the machine. The spring between the wood blocks held them apart when the brake was not being used. The steel plate, screwed to the wood blocks under the lever, kept the wood from wearing.

In operation, the operator tightens the brake by stepping on the pedal and tightening up the hand wheel. He starts the motor by moving the electrical controller to the first notch; then he releases the brake by unscrewing the hand wheel until the winding shaft starts to turn at the speed that he wants. When a few laps of stock have been wound around the shaft and the speed can be increased, he releases the brake by using the pedal catch to release the pedal. When the stock has been wound up, the machine is brought to a stop by pressing the pedal. The machine is then ready for the next strip of stock; no adjustment to the hand wheel is necessary.

This brake, although crude and probably inefficient as far as power is concerned, has saved the expense of an expensive electrical installation. The voltage of the generator has been set up to 230 volts so that the machines in the other departments give no trouble with speed fluctuations.

Heavy Grades Overcome by Tractor Haulage

H. S. KNOWLTON, *Boston, Mass.*

At the Thompsonville (Conn.) plant of the Bigelow-Sanford Carpet Company six industrial and four electric road trucks serve a floor area of 43 acres, six charging stations being provided at various strategic points on two floors to avoid loss of mileage in routing.

To facilitate certain haulage operations between different buildings without undue exposure to outside conditions, ramps have been provided, and in some cases the grades are as steep as 10 and 12 per cent. Truck schedules are designed to utilize the equipment as fully as possible in hauls between departments, avoiding idle mileage and lost time.

A typical interior run is performed by a 2,000-lb. tractor equipped with a large storage battery. The haulage calls for a load in both directions. First, it draws trailers of finished carpet from the Axminster finishing rooms over a 1,350-ft. route to the final inspection department. After disconnecting the load, trailers of yarn are returned over the same distance to the setting room, which is just below the finishing room. On the return trip the tractor hauls its load up 230 feet of 10 per cent grade. In another case a tractor hauls a load of from 1,200 to 1,500 pounds of wet wool 400 feet, over 100 feet being up a 12 per cent grade.

Besides handling raw material, one of the road-type trucks is equipped with an outrigger for snow plow attachment, and after every storm opens 93,200 sq.ft. of yard area on the premises.

Snapshots of improved methods and posting of photographs and workers' names with descriptions of the accomplishments helped bring out ideas at American Hard Rubber Company, Butler, N. J.

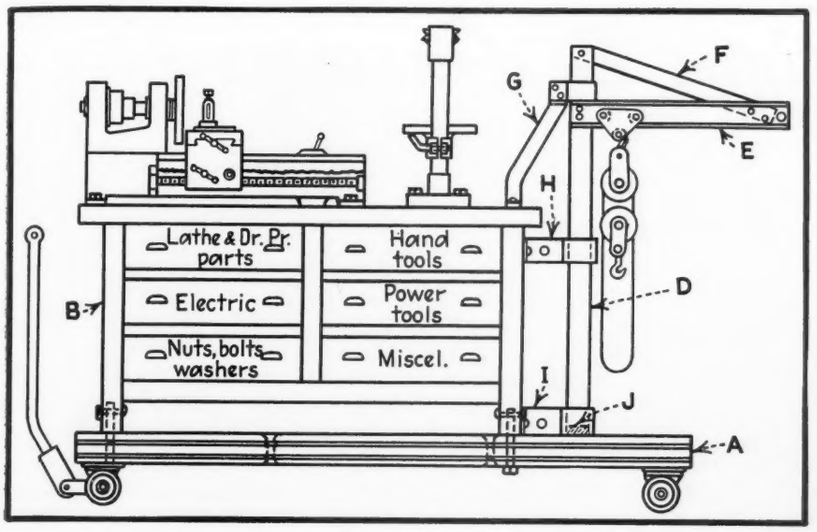
Machine Shop on Wheels

J. A. HONEGGER, *New York*

In a large plant where considerable maintenance work is to be done, the loss of time in carting parts to be machined from one department to another for the drilling of holes or turning of surfaces can become considerable.

To eliminate this condition in one plant the writer designed a maintenance truck upon which was carried the necessary apparatus to make all small and medium-sized repair jobs at the spot without moving any of the parts from the vicinity of the job.

The truck was given a rectangular frame *A* made of I-beams, above and below which was fastened 1-in. planking. On this platform a bench *B* was bolted. This bench contained drawers in which all types of hand and power-driven tools and miscellaneous parts were carried. At the end of the bench a derrick was mounted. This was made of a pipe stand *D* to which were fastened the channels *E*. These channels were supported on the outer end by the tie rod *F*. The pipe stand was fastened to the bench by means of straps *G*, *H* and *I*, and rested upon a steel shoe *J*. A trolley to which was hooked a chain bevel was mounted on the channels. The derrick could swing through an arc of more than 180 deg., making it possible to haul parts out of machines and swing them out of the way.



Upon the bench was mounted a 9-in. swing, individual, motor-driven lathe; an individual, motor-driven drill press; and a substantial vise. The bench had been made sufficiently narrow to permit a man to stand upon the platform while operating the machines.

When a repair call came in, the maintenance truck was hooked to an electric truck and towed to the point where the repair was to be made. Upon the job's completion the truck was either returned to the maintenance department or shunted to another repair assignment.

The concentration of all required apparatus in one unit saved much time and effort; the truck became so popular that two additional trucks were built and put into service.

Specially designed trucks, etc., of a New Jersey concern have men's names painted on them. They are seldom left out in the rain or allowed to become dirty.

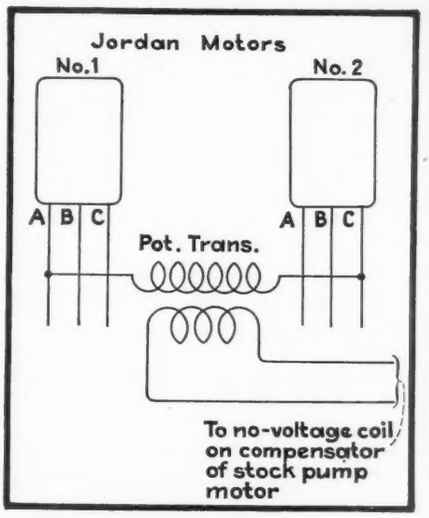
Interlock Protects Jordan Motors

C. E. ROGERS, *East Angus, Que., Canada*

Jordans on one of our large machines are driven by two 300-hp., 2,200-volt, 60-cycle motors. The stock pump to these jordans is driven by a 35-hp., 550-volt, 25-cycle motor.

Interruption of the 60-cycle supply or stopping of a jordan motor would formerly result in the head box overflowing before the machine tender could shut down the stock pump motor. This situation caused considerable loss of stock, damage to the jordan motors, and time lost while they were being repaired and dried out.

To prevent such occurrences, I connected the primary of a potential transformer to the leads of the jordan motors and the secondary of the



transformer to the no-voltage coil, which was rewound for 110 volts, 60 cycles, on the compensator of the stock pump motor. This arrangement protects against damage if the 60-cycle supply fails or the jordan motors trip out on overload.

Tool Makes Overhead Lamp Replacement Safe

SOURCE, *Westinghouse Lamp Company Bloomfield, N. J.*

Even so simple a procedure as lamp replacement is prone to accidents. That's why we prescribe a pole and prongs to replace old lamps in ceiling fixtures. Maintenance men can replace lamps from the floor without standing precariously on a ladder or some makeshift substitute, leaving themselves prey for a fall when a truck or careless worker goes astray. Then, too, the possibility of electric shock is minimized.

Now comes an added safety feature in a wire-mesh basket designed to protect the eyes from shattering

glass. Goggles have been used heretofore as a protection against old lamps that are so tight in their sockets that they shatter under twisting strain. The only trouble was that goggles as a safety measure were difficult to control. Often the men would fail to wear them when working in isolated locations remote from the supervisor's eye.

The wire basket removes this problem. Made of 100-mesh wire, shaped like a cone, it can catch shattering glass, but still is transparent enough to allow the worker to see what he is doing.

No eye accidents yet. Chalk up another score for precaution against potential injury.

SPECIAL NOTICE

$10 will be paid for the best Operating Short submitted during the month of January. The Editors are the judges. Other Shorts accepted will be paid for at attractive rates

Questions & Answers

CONDUCTED BY

G. A. Van Brunt

Method of Roughening Iron Floor Plates

Sheet-iron floor plates used around certain machines and in places where heavy trucking is done are very slippery when they become oily or wet. I shall appreciate it if readers will tell me the best and cheapest way of keeping these plates rough enough to reduce the chances of someone slipping on them. —*C.S.*

ELECTRIC or gas welding provides a simple method of roughening iron floor plates. Various designs, such as a checkerboard pattern or a series of dots and dashes, may be produced. It is not necessary to build the welded design up very high in order to prevent slipping.

When welding near oil-soaked floors or apparatus care should be taken not to create a fire hazard. For this reason it may be necessary to remove the plates before welding them.

P. LINDHOLM, *Newark, N. J.*

SHEET-IRON floor plates that become slippery can be roughened, or "ragged" effectively and cheaply by electric welding.

Arc welding of ⅛-in. rod to the plate will provide a permanent, roughened surface. The rod should be welded on in about 2-in. lengths, in a staggered pattern.

A triangular or round-shaped chisel driven by an air hammer or by hand will also roughen the surface satisfactorily. If a heavy chisel with a handle is available it can be used directly, without a hammer.

JOSEPH A. SCHNEIDER
Steubenville, Ohio

Removing Oil From Pipe System

Exhaust from a steam engine was formerly distributed to heating coils in process equipment through a system containing about 300 ft. of piping. No effort was made to remove oil from the steam; so the inside of the pipe has oil on it. Now we want to distribute steam through this piping to a service in which oil is highly objectionable. How can we remove the oil film from this pipe? The possibility of circulating a caustic soda solution through the pipe has occurred to us, but it would be difficult to do and we doubt whether such a solution would be very effective against the heavy oil. Have any other readers successfully met this problem? —*A.P.W.*

REMOVAL of oil deposits from an exhaust steam piping system may be accomplished in a number of ways. Before using any method of cleaning an initial blowing out of the lines with high-pressure steam will remove a considerable part of the deposits. Care must be taken, however, not to exceed the safe working pressure of the system, creating an injury hazard.

Where it is possible to break a number of joints in the piping a swab consisting of rags firmly secured to a strong, iron wire may be pulled through each section of the system. Soaking the rags in kerosene will help to remove the oil from the pipe. The lines should be thoroughly blown out with steam after using the swab.

If it is preferred, or necessary, to remove the oil by circulating a caustic solution through the system, some commercial cleaner may be used. A solution made from a mixture of equal parts of tri-sodium phosphate and soda ash will also give good results. Use 8 oz. of this mixture and 1 oz. of yellow soap powder to each gallon of water circulated. Steam jets should be used to keep the solution at the boiling point.

After all oil has been removed, the system should be washed out with hot water and then blown out with steam.

S. H. COLEMAN, *Waynesboro, Va.*

Answers Wanted

Using D.C. Generator for Welding

We have a 110-volt, 300-amp., compound-wound, d.c. generator which we want to use for arc welding. Is it possible to use it for this purpose? If so, will any changes have to be made in it? What size of reactor will be needed? —*F.A.E.*

What Causes These Explosions?

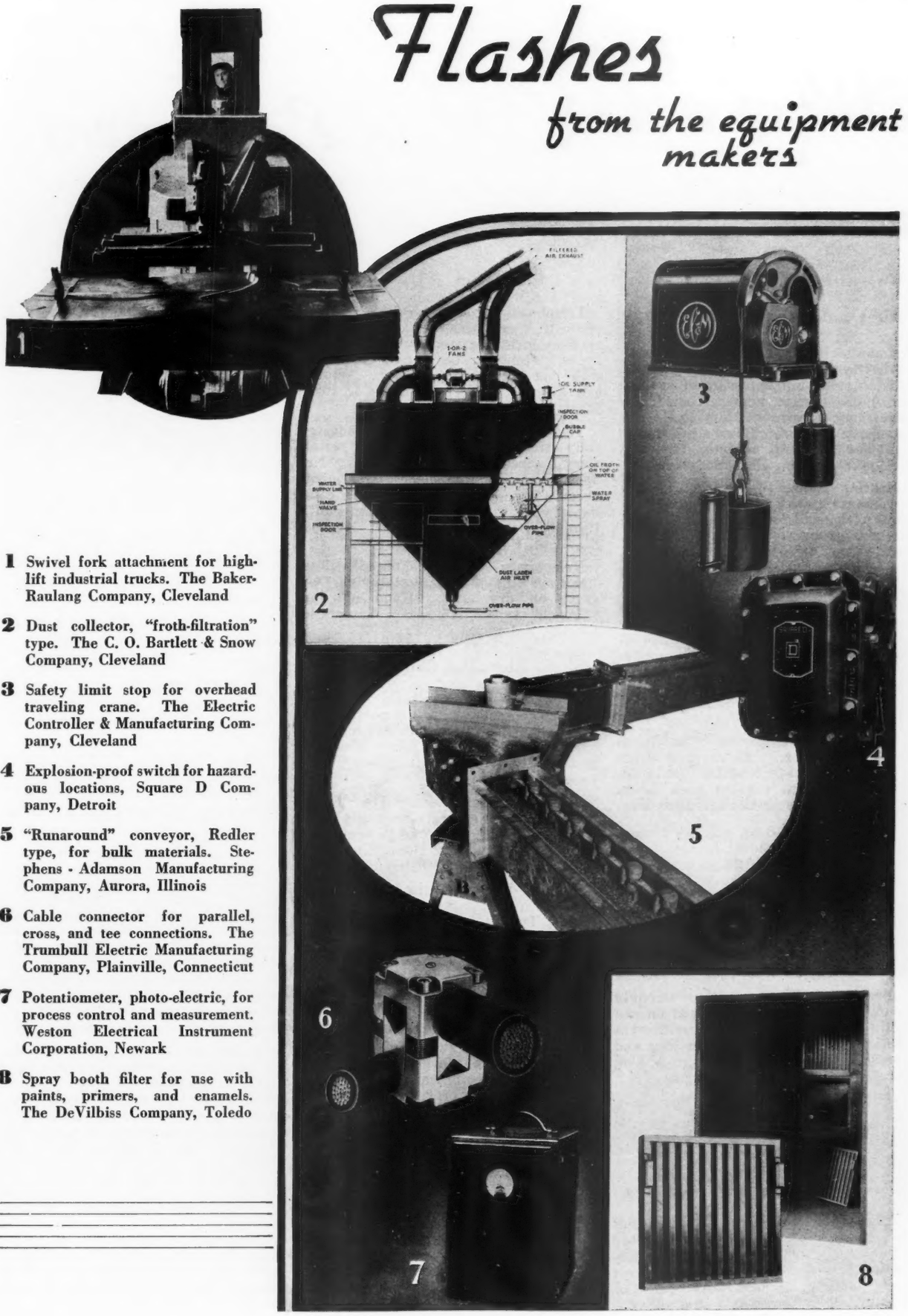
An occasional explosion in the hot air furnace that heats our plant seems to indicate improper firing, but we are not sure where the error lies. Fuel is anthracite pea coal. The furnace is fired twice a day by raking most of the red-hot coal to the front and piling up the fresh coal at the rear. The blower is kept running for four or five minutes to get combustion started, but sometimes there is a very annoying explosion. How should our method of firing be changed in order to avoid these explosions? —*H.D.*

How Fill Cracks in Wooden Beams?

Large cracks appear occasionally in the wooden beams of our plant buildings. They are unsightly and make us wonder whether they indicate structural weakness. If any readers have had similar experience it will be appreciated if they will explain what causes these cracks and tell us the best methods and materials to use for filling them, in order to prevent further deterioration and make them less conspicuous. —*R.F.*

Flashes

from the equipment makers



1 Swivel fork attachment for high-lift industrial trucks. The Baker-Raulang Company, Cleveland

2 Dust collector, "froth-filtration" type. The C. O. Bartlett & Snow Company, Cleveland

3 Safety limit stop for overhead traveling crane. The Electric Controller & Manufacturing Company, Cleveland

4 Explosion-proof switch for hazardous locations, Square D Company, Detroit

5 "Runaround" conveyor, Redler type, for bulk materials. Stephens - Adamson Manufacturing Company, Aurora, Illinois

6 Cable connector for parallel, cross, and tee connections. The Trumbull Electric Manufacturing Company, Plainville, Connecticut

7 Potentiometer, photo-electric, for process control and measurement. Weston Electrical Instrument Corporation, Newark

8 Spray booth filter for use with paints, primers, and enamels. The DeVilbiss Company, Toledo

What's NEW in Equipment

Air Conditioning, Ventilating, Heating

Air Dryer—Uses liquid drying agent. Self-contained unit made up of suction fan, liquid pump, heater, cooler, refrigerating tower, and drying tower. Automatic control. Four sizes, ranging 500-4,000 cu.ft. per min. Surface Combustion Corp., Dorr St., Toledo.

Heating Element—Electric, for use in connection with fan in heating systems. Dimensions 31x35x17 in. Consumes 2¾ watts per sq.in. Harold E. Trent Co., 618-640 North 54th St., Philadelphia.

Unit Heater—Direct-fired, floor type. Oil or gas, or can be supplied to burn coal or coke. Air passed over corrugated, heated plates and discharged at floor level. Steel construction, electrically welded. Lower portion of combustion chamber lined with insulating brick. Dravo-Doyle Co., Penn Ave., Pittsburgh.

Ventilator — "Monovent Continuous Ridge Ventilator." Seven sizes from 3 to 24 in. in 10-ft. lengths. Inner deflecting baffle to prevent back draft. Damper operates vertically. Burt Mfg. Co., Akron, Ohio.

Bearings

Bearings, Sleeve—Bores are grooved to leave diamond-shaped islands of metal. Grooves filled with graphite forced in under pressure and baked. Federal Bronze Products Co., 17-21 Newark Way, Maplewood, N. J.

Bearings — Textile belting strongly bound and woven to bring wear on end grain of fibers is saturated with synthetic resin and formed under heat and pressure. Joseph T. Ryerson & Son, Inc., Cleveland.

Pillow Block—Type SA. For heavy duty. Spherical roller bearings. Felt sealing rings. SKF Industries, Inc., Front St. and Erie Ave., Philadelphia.

Communication and Signaling

Signaling Equipment — Control unit for plant protection. Printed record of alarms, watch patrols, and manufacturing processes are printed in correct order at control desk. Autocall Co., Shelby, Ohio.

Telephone—Type 35A5 Wall Monophone for use with private telephone systems of either automatic or manual types. Handset, base, and cover of wall box are molded plastic. American Automatic Electric Sales Co., 1033 West Van Buren St., Chicago.

Telephone Booth — Interior acoustically treated with perforated metal sheet backed with balsam wood. No door necessary, for acoustic treatment absorbs sounds. Electric light in ceiling of booth. Telephone rests on shelf. Burgess Battery Co., 111 W. Monroe St., Dept. F., Madison, Wis.

Telephones — "Serv-U-Fones." For small systems of 3 to 10 stations. Operate on dry cells. Hand unit is "French" type. American Automatic Electric Sales Co., Chicago.

Electrical Control

Regulator — A.c. voltage regulator without contacts or moving parts. May be applied to units where exciter field current is 1 amp. or less. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

Relay—Manual reset. For signal circuits. Back contacts normally open when energized; failure of power closes contacts. Struthers Dunn, Inc., 140 N. Juniper Street, Philadelphia.

Relays—Induction-cylinder power relays for protecting mercury-arc rectifiers. Type CAW. General Electric Co., Schenectady, N. Y.

Starters — Series of d.c. automatic starters. With or without dynamic brake; reversing or non-reversing. Ward Leonard Electric Co., Mount Vernon, N. Y.

Switch—Angle switching equipment for controlling large synchronous-motor-driven reciprocating pumps and compressors to prevent compression strokes on different units from occurring in unison. Westinghouse Electric & Mfg. Co., East Pittsburgh.

Switch—Cam lever switch for use in circuits where breakdown requirements do not exceed 2,500 volts. The Gamewell Co., Newton, Mass.

Switch—Three-position, oil-immersed 7.5-kv. switch unit for mounting directly on, or in proximity to, a transformer. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago.

Switches—Line of single- and double-throw explosion-proof switches. Obtainable in 2 and 3 poles, 30-200 amp., 575 volts a.c., and 600 volts d.c. Square D Co., Detroit.

Time Switch—For short time intervals. Throwing single arm serves to set switch, start and time-set timer. Walser Automatic Timer Co., Mount Vernon, N. Y.

Electrical Protection Devices

Circuit Breakers—Oil-blast type for panel mounting. Type FK-43. Silver-to-silver contacts. Three poles inclosed in one frame. General Electric Co., Schenectady, N. Y.

Circuit Breakers—Type AB-F "Flip-on" 15-30-amp. circuit breakers for single-phase lighting and motor circuits. Type AB-1 "De-ion" breakers for light and power systems have four groups of ratings from 15 to 600 amp. Westinghouse Electric & Mfg. Co., East Pittsburgh.

Fuse—"Fusetrons." Plug type; in sizes 3½-30 amp. Fuse and thermal cutout features. Bussmann Mfg. Co., 2538 West University St., St. Louis.

Exhaust Systems

Dust Collector—Employs "froth flotation" principle. Dust-laden air passes through water bath which is covered with oil carpet. Automatic operation, no manual supervision required. All-steel construction and no fire hazard. Fans and motors used are only moving parts. Sizes: 1,000 to 35,000 cu.ft. per min. The C. O. Bartlett & Snow Co., Cleveland.

Filter—Spray booth filter for retarding discharge of heavy, sticky residue into exhaust chamber or pipe. Designed for use with paints, primers, and enamels. Filter assemblies held in place by spring clamps in welded metal frame. The DeVilbiss Co., Toledo, Ohio.

Filtering, Clarifying, Mixing

Homogenizer—Capacity 25 gal. per hr. Has 1-hp. motor. Parts coming in contact with material are stainless steel. Cherry Burrell Corp., West Randolph St., Chicago.

Fire Protection

Fire Extinguisher — "Arctic Anti-Freeze." Carbon dioxide contained in cylinder expels anti-freeze liquid when extinguisher is inverted and bumped. Rate of discharge automatically regulated to remain constant. American-LaFrance and Foamite Industries, Inc., Elmira, N. Y.

Instruments and Meters

Comparator—Model 110 Dial Comparator equipped with Model 95 Clear Vision Indicator. For measuring dimensions up to 5 in. to 0.000025 in. Diamond-tipped point. Indicator range 0.001 in. Federal Products Corp., 1144 Eddy St., Providence, R. I.

Control for Moisture Content.—The Foxboro Co., Foxboro, Mass., has acquired an interest in the Atlantic Precision Instrument Co., Malden, Mass., and will sell the "Verigraph," an instrument for controlling moisture content of paper and thickness of dielectric material, manufactured by the latter company.

Hydrometer—Automatic compensating hydrometer for controlling boiler salines. "Pacometer." Permutit Co., 330 West 42d St., New York.

Indicator — Phase-rotation indicator. Direction of 3-phase rotation indicated by neon glow lamps. General Electric Co., Schenectady, N. Y.

Indicator-Controller — For pressure and temperature control applications not requiring record of the factor under control. Will operate either diaphragm motor valve or air-operated control drive. Bailey Meter Co., Cleveland.

Meter — Rotary Displacement Meter for gas line measurements. For line pressures up to 25 lb. per sq.in. Normal capacity of 5,000 cu.ft. per hr. at 1-in. water gage differential. Roots-Connersville Blower Corp., Connersville, Ind.

Meter — "Sight Light Indicator." Illumination meter; range 0-250 foot-candles. Pocket size. Sight Light Corp., 342 Madison Ave., New York.

Potentiometer — For process control and measurement. Balances itself continuously at split-second intervals by photo-electric method. Weston Electrical Instrument Corp., 635 Frelinghuysen Ave., Newark, N. J.

Recorder — Automatic multiple-pen recorder for electrical or mechanical operations. Twelve pens. Automatic Electric Co., 1033 West Van Buren St., Chicago.

Stroboscope—"Strobotac," for speed measurement. Type 631-A. Operates from 115-volt, 60-cycle circuits; 600-12,000 flashes per min. General Radio Co., State St., Cambridge, Mass.

Temperature Control — For use in dead air spaces. Thermostat and relay glass-inclosed and contained in 4x5-in. switchbox. Relay rated at 400 watts. Thomas A. Edison, Inc., West Orange, N. J.

Timer — Electronic. Reads directly thousandths of a second. For 115 volts, 60 cycles, a.c., and 125 volts, d.c. General Electric Co., Schenectady, N. Y.

Lighting

Light Filter—Snaps over bulb and filters out red and yellow light rays. "Reco Daylight Hood." Reynolds Electric Co., West Congress St., Chicago.

Lighting Unit—For use with 400-watt high-intensity mercury vapor lamp or 750- to 1,500-watt incandescent lamp. No. 1590, "Hi-Bay." Curtis Lighting, Inc., 1123 West Jackson Blvd., Chicago.

Reflectors—For high-intensity mercury lamps in low bay mountings. Heat baffle protects socket. Steel or aluminum cover. "Lobay" Unit No. 695. Holophane Co., Inc., 342 Madison Ave., New York.

Reflectors — For use with mercury vapor lamps. For all types of mountings and all locations. Miller Co., Meriden, Conn.

Lubricants and Lubricating Devices

Lubricator—Addition to line of "Opto-Matic" constant level lubricators. No. 3, for maintaining constant level lubrication on ring or ball bearing shafts. Trico Fuse Mfg. Co., Milwaukee.

Lubricator—Automatic oiler for bearings operated by Telechron motor to feed 1-10 drops of oil at predetermined intervals. Light or heavy oils can be fed. Gits Bros. Mfg. Co., 1855 South Kilbourn Ave., Chicago.

Lubricator — "Drip-Drop" oiler for solid, wick, or waste-packed bearings. Bottle type. Three sizes. Trico Fuse Mfg. Co., Dept. F., Milwaukee.

Lubricator—"Stapax." Resinous material. Oil is drawn up by capillary action from trough in bottom of housing to bearing surfaces on shaft. Lubrication Products Co., 1400 West 25th St., Cleveland.

Materials

Plastic — Molded. High dielectric breakdown. Known as Material 2491. Three colors. General Plastics, Inc., North Tonawanda, N. Y.

Materials Handling

Chain and Cable Shackles — "Jerk-Release." Pin can be removed by jerking handline attached to pin eye after load has been released. Steel construction. Smith Devices, North 12th St., Philadelphia.

Conveyor—"Runaround" Redler conveyor. Series of skeleton flights, closely spaced on light conveyor chain, conveys steady column of bulk material through inclosed trough. Surplus is recirculated. Conveyor feeds itself uniform load from bin or spout. Horizontal curves can be negotiated. Stephens-Adamson Mfg. Co., Aurora, Ill.

Conveyor Roller—For conveyor belts 14-48 in. wide. Steel, 5 or 6 in. in diameter; iron, 6 in. in diameter. Closed ends, with felt oil seals. Portable Machinery Co., York, Pa.

Crane Stop—Improved "Youngstown Safety Limit Stop." For use in preventing overhoisting accidents on overhead traveling cranes. When limit stop is tripped it disconnects motor from power line and brings motor to rest quickly. The Electric Controller & Mfg. Co., 2700 East 79th St., Cleveland.

Lifting Device—Shifts filter press plates. One man can lift and shift 500 lb. Travels full length of press. Steel eye engages hooks on plates; movement of lever lifts plates. D. R. Sperry & Co., Batavia, Ill.

Swivel-Fork Attachment for Hy-Lift Truck—For general materials handling in the plant and for loading or unloading box cars. Especially adaptable to the handling of packaged sheet metal. One man and 5-ton truck can handle bundles up to 3 tons in weight, 30 in. in width, and 96 in. in length. The Baker-Raulang Co., 2178 West 25th St., Cleveland.

Thimble for Wire Rope Slings—Same size thimble used on both ends of sling, but either thimble will pass through the other. Macwhyte Co., Kenosha, Wis.

Truck—Heavy duty fork truck, Type ERX-6T. Power for lifting and lowering delivered through roller chains having safety factor of 9:1. Three motors—for traveling, hoisting, and tilting. Capacity 6,000 lb. Traveling speed of 525 ft. per min. Dynamic brakes on drive motor. Forks built to specifications. Gas-electric unit furnished when specified. The Elwell-Parker Electric Co., 4323 St. Clair Ave., Cleveland.

Mechanical Power Transmission

Belt-Splicing Plate—Guides rivets so that they cut through belt making slot running lengthwise with belt, to retain full tensile strength of belt. Bristol Co., Waterbury, Conn.

Belts—Complete line of V-belts for multiple and single drives. Two styles:

one single strand construction, one laminated construction. The B. F. Goodrich Co., Akron, Ohio.

Clutch—Friction. Sizes: 4 hp. at 1,200 r.p.m. to 11 hp. at 950 r.p.m. Asbestos lining. Fairbanks, Morse & Co., Chicago.

Couplings — For shafts. Copper-coated steel laminations held in slotted keeper by hardened steel crosspins welded in place. "Flexpin." Smith & Serrell, 30 Washington Pl., Newark, N. J.

Motor Base — Tension-control motor base for applications on spinning and twisting frames. Automatically changes belt tension to match changing load conditions. American Pulley Co., Philadelphia.

Speed Reducer—Horizontal speed reducer consisting of spiral bevel gears and continuous-tooth herringbone gears with motor mounted on top. Range 1-200 hp.; ratios from 8:1 to 45:1 or higher. D. O. James Mfg. Co., West Monroe St., Chicago.

Speed Reducers—Heavy duty worm-gear speed reducers for all Bodine N-5 motors. Will carry 1/6-hp. loads continuously. Eight gear ratios from 8:1 to 48:1. Can be mounted in practically any position. Bodine Electric Co., 2264 West Ohio St., Chicago.

Speed Reducers—Line of worm-gear speed reducers. Wide range of ratios and capacities. Single or double reduction in horizontal or vertical types. Roller bearings, automatic lubrication, and dustproof housings. Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia.

Variable Speed Transmission—P. I. V. gear transmission in 5 sizes up to 15 hp. capacity. Motor speed of 3,600 r.p.m. can be given speed range of 228-38 r.p.m. Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia.

Variable Speed Transmission—Speed adjustable to fraction of revolution per minute. With 1,200-r.p.m. motor speed, range is 0-150 r.p.m.; with 1,750-r.p.m. motor speed, 0-200 r.p.m. Lenney Machine & Mfg. Co., Warren, Ohio.

Metal Finishing

Anode Filter Bags—For electro-plating. Consist of two cloth bags, one fitting inside other, with filter paper between. Anode placed inside bags before being placed in solution. Hanson-Van Winkle-Munning Co., Matawan, N. J.

Plating Machine — Semi-automatic. Work racks are hung on chain conveyor and are moved at definite rate of speed (1-4 ft. per min.) to and from operator. Structural steel chassis. Many sizes. Udylite Co., Detroit.

Rustproofing Process — "Cromodizing." Steel surfaces protected by dipping or spraying with Cromodine. Chemical washed off after 1 min. leaving smooth, easy-to-paint finish. American Chemical Paint Co., Ambler, Pa.

Metal Working

Bandsaw—With continuous filing attachment. Uses saws of ⅛-⅝-in. widths, 9-10-ft. lengths. Maximum thickness of material 8 in. Table tilts 10 deg. in four directions. Neff, Kohlbusch & Bissell, Inc., 2400 West Madison St., Chicago.

Centering Machine—Two automatic heads and two air-operated vises for centering both ends of piece of work simultaneously. Pushbutton control. Available in bed dimensions of 5, 6, 8, and 10 ft. Seneca Falls Machine Co., Seneca Falls, N. Y.

Drilling Machine—Driven by 1/3-hp. motor from 110-volt, 60-cycle, a.c. line. Five speeds. Can drive ½-in. drills in metal or 4-in. tools in wood. W. B. & J. E. Boice, Norwood Ave., Toledo, Ohio.

Drilling Machines—Heavy duty, hydraulic-feed drilling machines for drilling, boring, and forming. Working parts fully inclosed. Three sizes. Can be had with simplified speed drive or with sliding-gear transmission for quick changes of speed. Baker Brothers, Inc., Toledo, Ohio.

Drilling Unit—Improved No. 3 automatic drilling unit. Cam and hydraulic operation. Drilling capacity 1⅛ in. in steel. Stroke, 3 in.; motor, 1/3 hp. High speed capacity up to 3,000 r.p.m. Millholland Sales & Machine Co., Indianapolis.

Drop Hammer — Model "E" steam drop hammer. Balanced slide valve. Laminated steel cushions holding air and grease between laminations relieve shock of blows while tieplate holds frames in alignment. Wear can be taken up between frame and anvil and frame and tieplate without disturbing any major part. Renewable bearing plates built into all thrust bearing surfaces. Safety cylinder cover. Chambersburg Engineering Co., Chambersburg, Pa.

Lathe — Ram-type, high-production, turret lathe. Three identical machines of different sizes: 1½-2½-in. bar capacity and 8-15-in. chucking capacity. Selective gear transmission permits change in spindle speed without passing through intermediate speeds. Gisholt-Machine Co., Madison, Wis.

Lathe—Semi-automatic; 12-in. Type "T" Double Carriage. Will accommodate main drive motor up to 10 hp. Automatic length feed stop. Spindle speeds up to 2,000 r.p.m. For smaller classes of production jobs. Monarch Machine Tool Co., Sidney, Ohio.

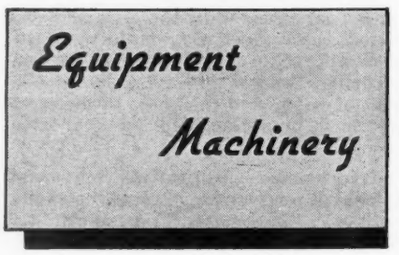
Lathe—Spindle speeds infinitely variable between 400-2,400 r.p.m. minimum and 600-3,600 r.p.m. maximum. Motors, 5, 7½, or 10 hp. The Lodge & Shipley Machine Tool Co., Cincinnati.

Lathes—No. 3 "Hi-Speed" step-turning lathe for production, powered by Transitorq coupled to electric motor of 5 to 10 hp. No. 4C heavy duty engine lathe for manufacturing and maintenance operations. Constant-speed, reversing, 5-hp. motor. Twelve spindle speeds ranging 30-1,200 r.p.m. Hendey Machine Co., Torrington, Conn.

Milling Machine — MD5 precision milling machine. Range: 13¾ in. longitudinal, 6 in. traverse, and 7 in. vertical. Six speeds forward and six reverse ranging 120-1,190 r.p.m. Hardinge Brothers, Inc., Elmira, N. Y.

Milling Machine—No. 2, Type L, universal machine. Spindle speeds range 23-1,200 r.p.m.; 15 speeds in all. Motor is 3 hp., connected through V-belts. Motor-reversing lever with interlock to prevent reversing while motor is operating. Cincinnati, Ohio.

Power Hacksaw—Hydraulic feed. Five sizes from 8x8 in. to 16x16 in. Saw frame heavily ribbed to prevent distortion; runs in dustproof, angular



slide. Two stroke speeds. Columbo Machine Co., Liberty St., New York.

Press — Automatic, high-production press. Motor of ½ hp. drives flywheel at 700 r.p.m. Variation can be made in feed from 0 to 1 in. Positive adjustment of tandem roller mechanism. E. W. Bliss Co., Toledo, Ohio.

Press — Molding and broaching hydraulic arbor press. No. 60. Pressures obtainable ½-15 tons on downstroke and ½-13 tons upstroke. Receives diameters up to 18 in. Foot- or hand-operated control valve. Greenerd Arbor Press Co., Nashua, N. H.

Punch Press — No. 5½R inclinable, open-back punch press. Split-plug and drawbolt to lock adjusting screw to connecting rod. Alloy crankshaft. Capacity 56 tons. Rockford Iron Works, Rockford, Ill.

Tool Grinder—No. 2 universal tool and cutter grinding machine. Hydraulic table traverse. Will handle work 12 in. in diameter; 28 in. in length with universal head and 31¾ in. in length with left-hand footstock. Norton Co., Worcester, Mass.

Miscellaneous

Battery Charger—Automatically meters charge to battery to meet its condition. Available only for 24-cell class of battery. Disconnecting switch is only control. Westinghouse Electric & Mfg. Co., East Pittsburgh.

Centrifugal—Continuous solid-bowl centrifugal for extracting solids or clarifying liquids that cannot be filtered. Capacities ½-5 tons of solids per hr., dry weight. Bird Machine Co., South Walpole, Mass.

Motors

Motor — Totally inclosed d.c. motor having external fan and shroud on commutator end. Brushes accessible after removing only one cover from bracket. Westinghouse Electric & Mfg. Co., East Pittsburgh.

Motor — Totally inclosed, explosion-proof motor; 300 hp., 3,600 r.p.m. Self-cooled by passing air over exterior. Ball bearings and oil lubrication. Westinghouse Electric & Mfg. Co.,-East Pittsburgh.

Packaging

Strapping Stand—All-steel reel stand for handling steel strapping. Automatic brake. The Stanley Works, New Britain, Conn.

Paint and Painting Equipment

Finish — For protecting wood, concrete, plaster, etc. Base of vegetable gums and heat-treated oils. Applied by brushing, spraying, or dipping. Technical Coatings, Inc., 9-15 Park Place, New York.

Paint Agitator Tanks—Four tanks in circulating unit. Paint kept agitated and delivered to spray guns by ¾-hp. motor-driven pump on each tank. Excess paint is filtered and recirculated. Binks Mfg. Co., Carroll Ave., Chicago.

Piping, Valves, and Fittings

Hose Coupling—Sleeves, allow rotation and horizontal movement. Available for all standard hose sizes. Scheiwer Master Coupler Co., Erie, Pa.

Steam Main — Self-contained unit steam main for underground distribution lines. Asphalt coated galvanized iron with waterproof, asbestos insulation. In portable units, including pipes, supports, liner, conduit sections. RicwiL Co., 1562 Union Trust Bldg., Cleveland.

Valve—Electro-hydraulic. Pilot valve electrically operated. Hydraulic pressure gives tight seating. The Wm. Powell Co., Cincinnati.

Valve—Relief valve with cup-shaped disk. Pressure transmitted to space within cups is confined and made uniformly effective over entire inner head of disk. Klipfel Mfg. Co., 2641 West Harrison St., Chicago.

Portable Power Tools

Drills, Portable Power—Line of universal drills ranging in size from ⅛ in. to 1 in. Some models are heavy duty, others standard. Chicago Pneumatic Tool Co., 6 East 44th St., New York.

Sanders, Portable — Redesigned line. Four models: three 7-in., one 9-in. Universal motors for 110, 220, or 250 volts. Black & Decker Mfg. Co., Towson, Md.

Power Plant Equipment

Boiler—Type "CP" water-tube boiler. Completely steel-incased and insulated. Furnace sides watercooled. Sizes to 2,500 sq.ft., pressures to 450 lb. Built-in soot blower. Staggered tubes. Top ends of water-wall tubes discharge directly into upper drum. E. Keeler Co., Williamsport, Pa.

Cleaner — For small tubes. Air driven. For straight and curved tubes down to ⅝ and ⅞ in. outside diameter respectively. "Roto Jr." Roto Co., 142 Sussex Ave., Newark, N. J.

Compressor—Has 75-hp. motor operating from 440-volt, 60-cycle line. Motor armature mounted on same shaft that serves compressor. Sectional intercooler. Le Roi Co., South 68th St., Milwaukee.

Concrete — Hydraulic insulating refractory concrete. "Insulcrete." For poured refractory furnace linings. Quigley Co., Inc., 56 West 45th St., New York.

Diesel Engine — Redesigned models. Ratings: D13000, 125 b.hp. max., 95 b.hp. continuous duty; D8800, 77 b.hp. and 59 b.hp. respectively; D6100, 47 b.hp. and 37 b.hp. All are 4-cycle, gasoline-engine starting. Cylinders 6, 4, and 3, respectively, 5¾x8 in. Force feed lubrication. Individual fuel pumps. Steel channel base. Engine cooling systems interconnected. Caterpillar Tractor Co., Peoria, Ill.

Diesel Engines—Two classifications: general service and direct-connected for electric service. Four-cycle, direct-injection, pressure-lubricated. May be converted to gas engine by few minor changes. Poppet-type air-starter valve with removable cage. Sizes 100-800 hp. Chicago Pneumatic Tool Co., 6 East 44th St., New York.

Filter—For diesel fuel oil. Two elements: one metal, one metal inclosed in woolen fabric. "Purolator." Motor Improvements, Inc., 365 Freylinghuysen Ave., Newark, N. J.

Furnace Draft Controller—Forced or uptake. Draft measured by large diaphragm whose movement actuates air pilot valve admitting pressure to one end or the other of a drive cylinder. Bailey Meter Co., Cleveland.

Gas Burner—For low-pressure gas and air. Series F, "Pilotend." Control obtained by means of air valve. Several sizes. For boilers, kilns, and furnaces. Eclipse Fuel Engineering Co., Rockford, Ill.

Heaters—Fuel oil heaters. Use live steam at boiler pressure to reduce viscosity of fuel oil before burning. Straight-tube, multipass design. Vertical or horizontal operation. Patterson-Kelley Co., East Stroudsburgh, Pa.

Packing — Semi-metallic. Insert of thin ribbons of soft babbitt foil. Insert fastened to asbestos channel impregnated with lubricant. Crane Packing Co., 1801 Cuyler Ave., Chicago.

Pumps—Centrifugal pumps for supplying feed water to high pressure boilers. Meet difficult conditions of temperature and pressure. De Laval Steam Turbine Co., Trenton, N. J.

Separator—Type RV purifier to remove oil from exhaust steam. Two stages: one recovers bulk of oil, second refines it. Centrifix Corp., 3029 Prospect Ave., Cleveland.

Stoker—Burns all types and grades of coal. Over-running rotor of cast-iron segments. Coal fed to rotor by large, slow-speed, reciprocating feeder shoe. Eccentric gears and variable feed controls sealed in case and submerged in oil. Made in one or two parts. Wm. Bros. Boiler & Mfg. Co., Minneapolis.

Tiles—For use as rear arches on horizontal return tubular boilers. Purpose is to provide turbulence in gases so that all tubes receive equal proportion. Geo. P. Reintjes Co., Kansas City, Mo.

Turbines—Two steam turbines. One rated at 90 hp., other at 150 hp. Vertical or horizontal operation. Furnished with built-in speed reducers for driving low-speed equipment. Coppus Engineering Corp., 375 Park Ave., Worcester, Mass.

Valve—Forged steel blow-off valve. For two pressure ranges, 600 and 1,500 lb. Stainless steel disk and seat ring. Yarnall-Waring Co., Chestnut Hill, Philadelphia.

Safety Equipment

Goggle Lens — "6-Curve Super Armorplate." Manufacturer claims that it will withstand blow having 12 times the energy of specified standard for a protective lens. American Optical Co., Southbridge, Mass.

Textile

Dryer — "Hurricane," pin, tenter dryer. One operator can run it. Automatic safety stop shuts down dryer if cloth leaves pins. Air circulation can be varied to accommodate different classes of fabrics. Frame of structural steel. Philadelphia Drying Machinery Co., 3351 Stokley St., Philadelphia.

Fingering Machine—Has 16 needles in each plate, 5-9 needles per in. and 6-in., brass, drop jacks. Overall length 24 in. Lamb Knitting Machine Corp., Chicopee Falls, Mass.

Loom—For weaving ladder tape used in making Venetian blinds. Known as 15-ft. 8-in. model. Equipped with 24-space, 4-bank batten, selective change motion and shuttle motion, 12-harness head motion. Fletcher Works, Glenwood Ave. and 2d St., Philadelphia.

Wheels — Cellulose - acetate plastic

Tenite applied to traverse wheels or disks of cop or quill winders. Tennessee Eastman Corp., Kingsport, Tenn.

Tools and Supplies

Blown Fuse Indicator—For use with ferrule or knife-blade, single- and double-throw switches. Ratings: 110-600 volts, up to 600 amp. F. C. LaMar Indicating Fuse Corp., Chrysler Bldg., New York.

Brake Lining—No. 900 woven and compressed brake lining. For use on all kinds of heavy industrial equipment. Johns-Manville, 22 East 40th St., New York.

Caliper Rule — Stainless steel. No. 391-A. Three in. long. Graduations to sixty-fourths of an inch. The Brown and Sharpe Mfg. Co., Providence, R. I.

Clamp — "Pony" clamp No. 251. Opening of 1 in. and throat depth of 1½ in. Adjustable Clamp Co., 417 North Ashland Ave., Chicago.

Die Heads — Adjustable bolt die heads and dies for use in No. 00 ratchet, in 7 sizes from ⅜ to 1 in. Dies cadmium plated. The Toledo Pipe Threading Machine Co., Toledo, Ohio.

Jack—For stretching, pulling, binding, or lifting. Unit includes frame with operating parts, 10-ft. stretcher chain, and 5-ft. anchor chain. Loads up to 4,000 lb. American Chain Co., Inc., Bridgeport, Conn.

Lamps—Emergency lamps for watchmen and trouble shooters. Wet-cell batteries. Two-filament lamps. Sizes 1,000-250,000 beam candlepower. Carpenter Mfg. Co., Boston.

Nut—Said to be vibration proof. Spring-tempered retainer is nested in counterbored recess of nut. Machinery Products Corp., 2020 North Major Ave., Chicago.

Pliers—Set of four 4½-in. pliers for electrical work. K-D Mfg. Co., Lancaster, Pa.

Saw — Hole saw with replaceable blades that cut holes from ⅞ to 4⅛ in. in diameter in wood, metal sheets, and pipe. E. C. Atkins & Co., Indianapolis.

Saw — Radial with 8-in. blade mounted on turntable so that it can be swung through 90 deg. for ripping or cross-cutting. Universal motor for 110 or 220-volt operation. J. D. Wallace & Co., South California Ave., Chicago.

Stocks and Dies—For threading thin metal tubing. Greenfield Tap and Die Corp., Greenfield, Mass.

Vise—For holding thin-walled copper and brass tubing while it is being cut. Has guide for hacksaw. Trimont Mfg. Co., Amory St., Roxbury, Boston, Mass.

Welding and Cutting

Electrode—Arc Welding. For welding stainless steels of 25-12 variety. Sizes: $\frac{5}{32}$ and $\frac{3}{16}$ in. in 11-in. lengths. "Stainweld B." The Lincoln Electric Co., Cleveland.

Reduction Regulator—For delivering large (more than 1,000 cu.ft. per hr.) volumes of oxygen at high pressures. "Airco-DB Style 8490." Air Reduction Co., Lincoln Bldg., New York.

Stud — "Hardened Metallic Drive Screw Welding Stud." To be used in welding cast iron to steel, repairing breaks in castings, and welding cast iron. Parker-Kalon Corp., 200 Varick St., New York.

Welder — Combination welder and trimmer for working flexible shafts, wire, and cable. Operates on 110 or 220 volts. Eisler Engineering Co., Inc., Newark, N. J.

Welder—Handles up to ⅛-in. welding rod. For use on 110- or 220-volt a.c. lines. Housed in steel case. Weighs 135 lb. Dongan Electric Mfg. Co., Franklin St., Detroit.

Welding Torch—Has shut-off valve in handle; operated by thumb lever. When pressure on lever is released flame reduces to pilot size. Weldit Acetylene Co., Detroit.

Weld-Strength Tester — Portable machine can exert stress of 40,000 lb. per sq. in. on welds of specimens 10 in. long, 1½ in. wide, and ½ in. thick. Greater intensities on smaller specimens. Air Reduction Sales Co., Lincoln Bldg., New York.

Wire and Wiring Devices

Cable Connector—For parallel, cross, and tee connections. Sizes No. 4—1,000,000 circ.mil. "PXT." The Trumbull Electric Mfg. Co., Plainville, Conn.

Connector — Solderless. Duralumin with bimetal washers. For connecting copper cable with aluminum conductors. Burndy Engineering Co., New York.

Change in Name

Toledo Synthetic Products, Inc., makers of "Plaskon," urea molding material, have announced a change in

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TRADE LITERATURE

BEARINGS—Bulletin No. 232, on ball bearings and housings for fans and blowers.—SKF Industries, Inc., Front St. & Erie Ave., Philadelphia.

BELT DRIVES—Catalog No. 278, on V-belt drives.—T. B. Wood's Sons Co., Chambersburg, Pa.

CENTRIFUGAL PUMPS—Four leaflets: 2206, on large low-head, double-suction, single-stage Type S pumps; 2207, on same for high head; 2208, on small double-suction, single-stage pumps; 2210, on Type M multi-stage, double-suction pumps.—Allis-Chalmers Mfg. Co., Milwaukee.

CONTROLLERS—Folder, on line of air-operated controllers.—The Brown Instrument Co., Philadelphia.

CONVEYOR—Bulletin No. 96, on pivoted bucket conveyors.—Robins Conveying Belt Co., 15 Park Row, New York.

DUPLICATING MACHINE—Folder, describing Fordigraph duplicating machine.—American Fordigraph Corp., 2 West 45th St., New York.

ELECTRICAL INSTRUMENTS—Broadside E, showing electrical measuring instruments.—Leeds & Northrup Co., 4902 Stenton Ave., Philadelphia.

FRICTION MATERIAL — Catalog, on Condor asbestos friction material.—The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J.

GEARS — Folder, on gears and other power transmission products.—Boston Gear Works, Inc., North Quincy, Mass.

HUMIDIFIER—Folder, describing Vigor-Aire Humidifier.—Merion Sporting Goods Mfg. Corp., 127 South 5th St., Philadelphia.

MATERIALS HANDLING—Section 106 of General Catalog 100, on bulk material handling machinery for elevating and conveying.—Palmer-Bee Co., Westminster and G. T. R.R., Detroit.

MEASURING INSTRUMENT — Leaflet, describing roller type thread gage Model 897.—Federal Products Corp., Providence, R. I.

NAILS—Folder, price list of line of roofing nails.—W. H. Maze Co., Peru, Ill.

PILLOW BLOCKS—Bulletin No. 233, describing Type SA pillow blocks.—SKF Industries, Inc., Front St. and Erie Ave., Philadelphia.

PNEUMATIC TUBES—Catalog, on pneumatic dispatch tubes.—The Lamson Co., Syracuse, N. Y.

PUMPS—Bulletin W-101-B1A, on Type VC horizontal duplex piston pumps.—Worthington Pump and Machinery Corp., Harrison, N. J.

REFLECTOR—Folder, on "Lobay" Unit No. 695 reflector for use with mercury lamps.—Holophane Co., Inc., 342 Madison Ave., New York.

ROOFING—Booklet, title "Facts About Roofing."—The Flintkote Co., 50 West 50th St., New York.

SPEED REDUCER—Catalog No. 1519, on Herringbone Gear reducer.—Link-Belt Co., 307 North Michigan Ave., Chicago.

SPEED REDUCERS—Catalog No. 1524, gives information and engineering data on speed-reducer units.—Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia.

STEEL — Booklet, on Nickel-Clad steel and equipment.—Lukens Steel Co., Coatesville, Pa.

STEEL—Folder, describing advisory field service for users of steel.—Union Drawn Steel Co., Massillon, Ohio.

STEEL TUBING — Leaflet, describing wide use of steel tubing.—Summerill Tubing Co., Bridgeport, Montg. Co., Pa.

SWITCH — Data sheet, on cam lever switch A-20291-A for circuits where breakdown requirements do not exceed 2,500 volts.—The Gamewell Co., Newton, Mass.

TOOLS—Catalog 20,000-1 on Elesco non-sparking tools. The Superheater Co., 60 East 42d St,. New York.

VALVES—Catalog, on line of valves for automotive equipment.—The Toledo Steel Products Co., Toledo, Ohio.

WIRE ROPE—Folder 35-151, announcing thimbles for wire rope slings.—Macwhyte Co., Kenosha, Wis.

WOOD FLOORING—Folder, on heavy duty finishes for maple flooring.—Maple Flooring Manufacturers Assn., McCormick Bldg., Chicago.